BS 499-1:2009

BSI British Standards

Welding terms and symbols

Part 1: Glossary for welding, brazing and thermal cutting

raising standards worldwide™

BSI British Standards

Publishing and copyright information
The BSI copyright notice displayed in this document indicates when the document was last issued

ISBN 978 0 580 58471 8

ICS 01.040.25; 25.160.01

The following BSI references relate to the work on this standard:
Committee reference WEE/1
Draft for comment 08/30162761 DC

Publication history
First published August 1933
Second edition June 1939
Third edition October 1952
Fourth edition October 1965
Fifth edition November 1983
Sixth edition February 1991
Seventh edition December 2008

Amendments issued since publication

Date	Text affected

Contents

List of figures

List of tables

Summary of pages

This document comprises a front cover, an inside front cover, pages i to viii, pages 1 to 142, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 499 is published by BSI and came into effect on 31 December 2008. It was prepared by Technical Committee WEE/1, *Definition and symbols for welding*. A list of organizations represented on this committee can be obtained on request to its secretary.

Supersession

This part of BS 499 supersedes BS 499-1:1991, which is withdrawn.

Relationship with other publications

This standard has been aligned, as far is as practicable, with existing European and international lists of terms and definitions for welding, including BS EN 1792:2003, PD CEN/TR 14599, BS ISO 857 (all parts) and BS EN 13622. There might not be full agreement with standards that have not been adopted as British Standards. Where it was felt that an existing definition needed clarification, this has been done while striving to not contradict the existing definition. As far as practicable, the numbering system used in this standard follows that of BS EN 1792:2003 with new numbers allocated to terms that are not in the European standard.

Where definitions are based on those in a European or international standard, the identifier of the original standard is given in square brackets after the definition.

BS 499 is published in two parts, with a supplement to this part:

- Part 1: Glossary for welding, brazing and thermal cutting
- Part 1, Supplement: Definitions for electric welding equipment
- Part 2c: European arc welding symbols in chart form

NOTE 1 BS 499-1, Supplement is a reproduction of IEV 50 (851):1991.

NOTE 2 BS 499-2c is based on BS EN 22553.

Information about this document

This is a full revision of the standard, and introduces the following principal changes:

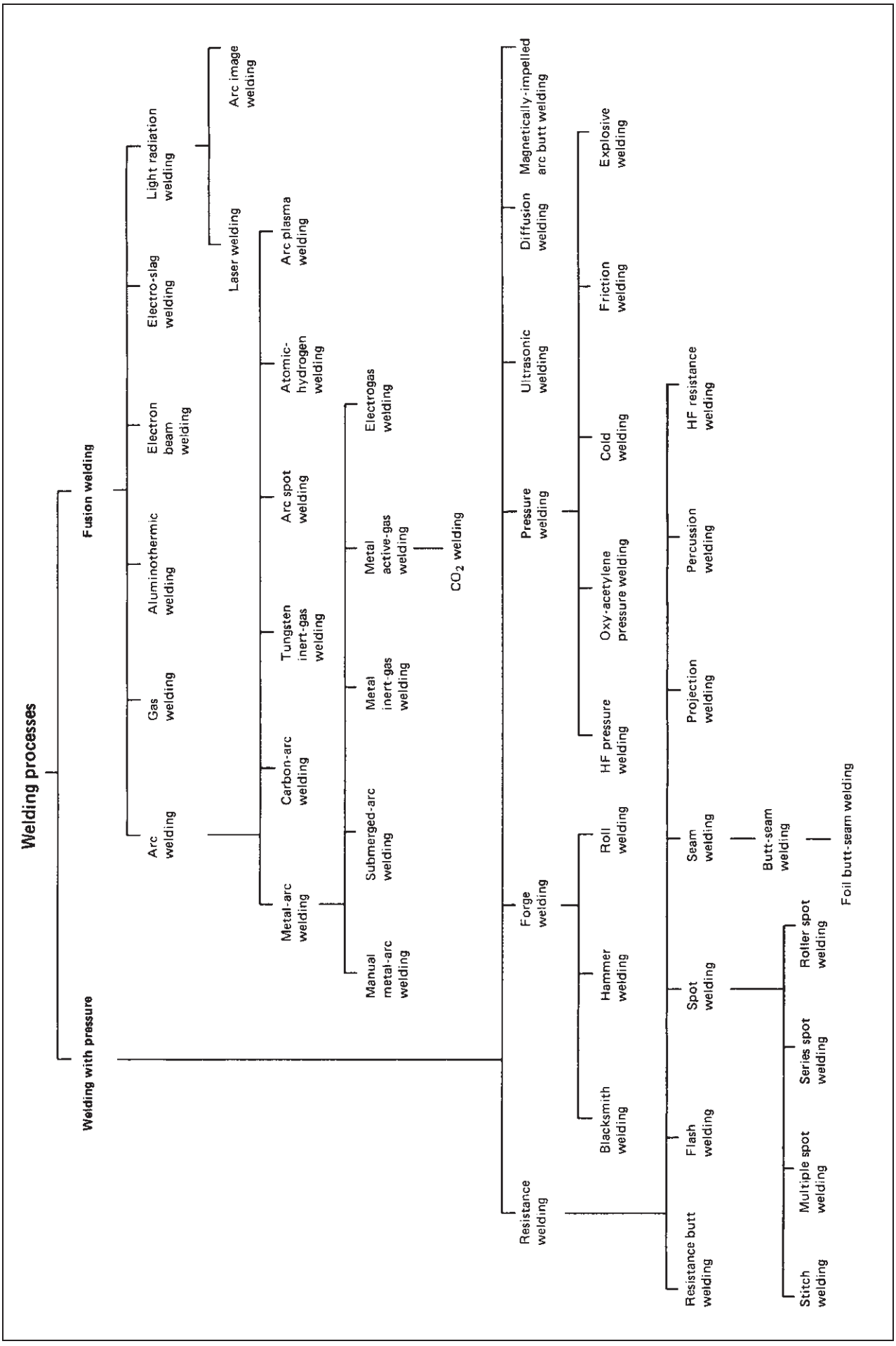
Charts showing the derivation of welding, cutting and allied processes are given in Figure 1, Figure 2 and Figure 3.

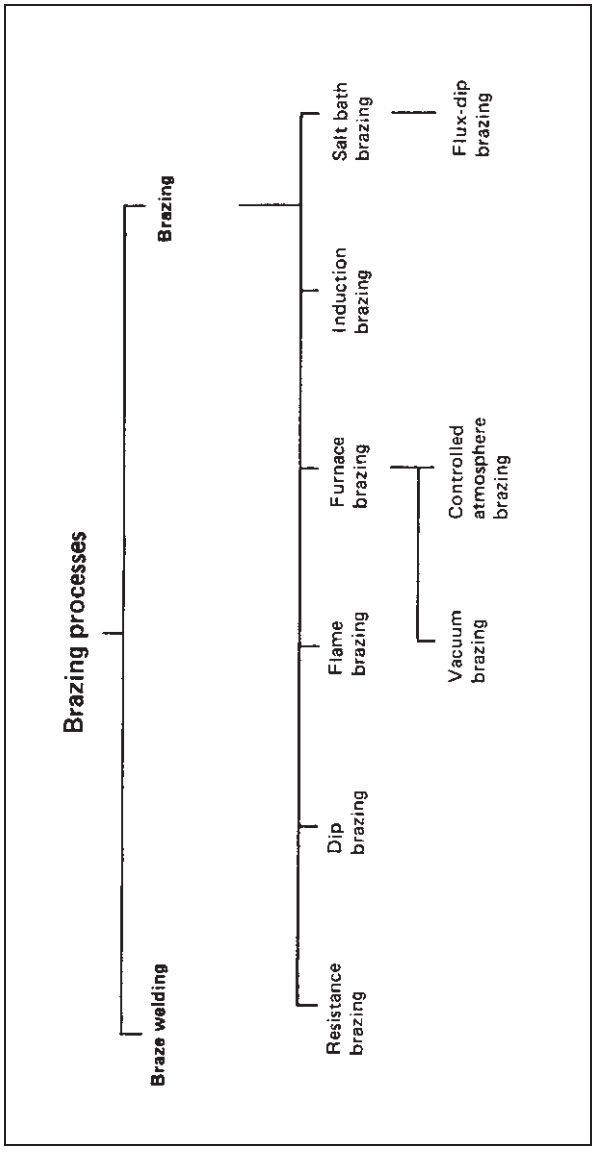
Commonly used friction stir welding terms are included in the new Section **27**.

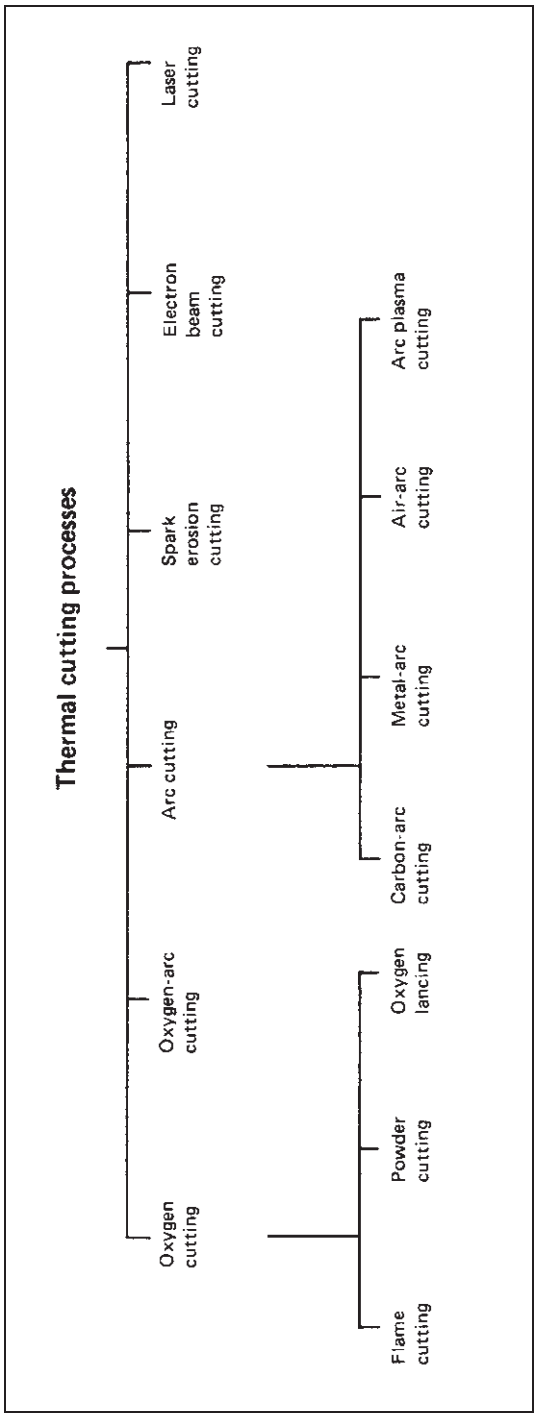
Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.


Welding processes
Welding with pressure
Fusion welding
Arc welding
Gas welding
Aluminothermic welding
Electron beam welding
Electro-slag welding
Light radiation welding
Laser welding
Arc image welding
Metal-arc welding
Carbon-arc welding
Tungsten inert-gas welding
Arc spot welding
Atomic-hydrogen welding
Arc plasma welding
Manual metal-arc welding
Submerged-arc welding
Metal inert-gas welding
Metal active-gas welding
Electrogas welding
CO_2 welding
Forge welding
Pressure welding
Ultrasonic welding
Diffusion welding
Magnetically-impelled arc butt welding
Resistance welding
Blacksmith welding
Hammer welding
Roll welding
HF pressure welding
Oxy-acetylene pressure welding
Cold welding
Friction welding
Explosive welding
Resistance butt welding
Flash welding
Spot welding
Seam welding
Projection welding
Percussion welding
HF resistance welding
Stitch welding
Multiple spot welding
Series spot welding
Roller spot welding
Butt-seam welding
Foil butt-seam welding


Brazing processes
Brazing
Braze welding
Resistance brazing
Dip brazing
Flame brazing
Vacuum brazing
Furnace brazing
Controlled atmosphere brazing
Induction brazing
Salt bath brazing
Flux-dip brazing


Thermal cutting processes
Oxygen cutting
Flame cutting
Powder cutting
Oxygen lancing
Oxygen-arc cutting
Arc cutting
Carbon-arc cutting
Metal-arc cutting
Air-arc cutting
Arc plasma cutting
Spark erosion cutting
Electron beam cutting
Laser cutting

This page deliberately left blank.

1 Scope

This standard provides terms, symbols and definitions for welding, brazing and thermal cutting of metals. Some definitions might also apply to non-metals.

It does not cover mechanically fastened or adhesive bonded joints.

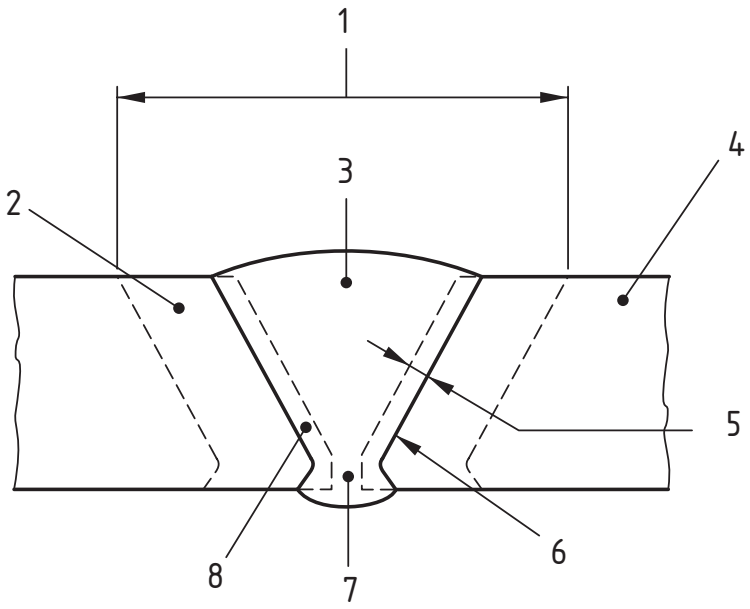
This standard is intended for designers, those drafting welding specifications, welding production, manufacturers and inspection personnel.

Preferred and equivalent terms are given in bold type. Non-preferred terms are given in medium type. Deprecated terms are indicated as such.

Section 1. Terms common to more than one section

No.	Term	Definition
10 001	**welding**	joining process in which two or more parts are united producing a continuity in the nature of the workpiece material(s) by means of heat or pressure or both, and with or without the use of filler material
10 002	**weld**	union of pieces of material resulting from welding
10 003	**welder**	operator who performs or controls the welding process
10 004	**welding operator**	person who controls fully mechanized or automatic fusion welding processes
10 005	**welding plant** welder: *deprecated*	apparatus for providing and controlling energy, and movement if necessary, for making a weld
10 006	**welding process**	particular method of welding involving the application of certain metallurgical, electrical, physical or mechanical principles
10 007	**manual welding**	welding where the electrode holder, welding hand gun, torch or blowpipe is manipulated by hand
10 008	**partly mechanized welding**	manual welding where the wire feed is mechanized
10 010	**mechanized welding**	welding in which the welding parameters are maintained within a suitable tolerance by mechanical or electronic means and which may be manually varied during the welding process to create the required welding conditions
10 011	**automatic welding**	welding in which all operations are preset and performed automatically during the process
10 012	**strength weld**	weld designed to withstand stress
10 013	**parent metal** base metal: *deprecated*	metal to be joined or surfaced by welding, braze welding or brazing (See Figure 4.)
10 014	**filler metal**	welding consumable added during welding to form the weld
10 015	**filler wire** welding wire	filler material in the form of a wire which may or may not be a part of the welding circuit
10 016	**filler rod** welding rod: *deprecated*	filler material in the form of a rod which may or may not be a part of the welding circuit
10 017	**flux**	material used during welding, brazing or braze welding to clean the surfaces of the joint chemically, to prevent atmospheric oxidation and to reduce impurities *NOTE In arc welding, many other substances, which perform special functions, are added.*
10 018	**deposited metal**	filler metal that has been added during welding
10 020	**weld metal**	all metal melted during the making of a weld and retained in the weld (See Figure 4.)
10 021	**run** pass	metal melted or deposited during one passage of an electrode, or torch or blowpipe

Figure 4 **Root, fusion penetration, weld junction and zones of typical welds**



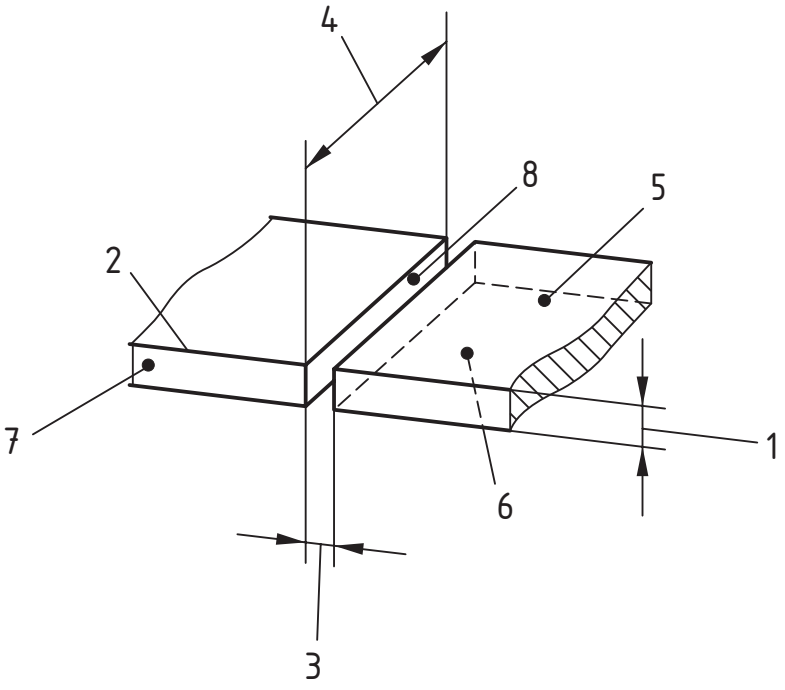
No.	Term	Definition
10 022	**deposition rate**	mass of filler metal consumed per unit of productive welding time
10 023	**weld zone**	zone containing the weld metal and the heat-affected zone (See Figure 4.)
10 024	**heat-affected zone HAZ**	portion of non-melted parent metal whose microstructure has been affected (See Figure 4.)
10 025	**fusion zone**	part of the parent metal that is melted into the weld metal, as determined on the cross-section of a weld (See Figure 4.)
10 026	**fusion line**	interface between the weld metal and the non-melted parent metal as determined on the cross-section of a fusion weld
10 027	**welding technique**	manner in which an operator manipulates an electrode, a blowpipe or a similar appliance
10 028	**welding procedure**	specific course of action followed in welding, including a list of materials and, where necessary, tools to be used (See Annex A to Annex G.)
10 030	**(welding) sequence**	order and direction in which joints, welds or runs are made
10 031	**weld run sequence**	order in which the runs of a weld or deposited layer are produced
10 032	**stud welding**	joining of a metal stud or similar part to a workpiece *NOTE Welding may be accomplished by arc, resistance, friction or other suitable process, with or without external gas shielding. The weld is made over the whole end area of the stud or attachment.*
10 033	**hard facing** hard surfacing	application of a hard, wear-resistant material to the surface of a component by welding, braze welding or spraying
10 034	**spatter**	globules of metal expelled during welding or cutting

No.	Term	Definition
10 035	**duty cycle**	1) *In the sense of "welding operator" duty cycle*, ratio of time spent welding to the total time which includes other activities, e.g. changing electrodes, slag removal 2) *In the sense of "machine" duty cycle*, measure of the capability of the welding equipment
10 036	**transferred arc**	arc established between the electrode of the plasma arc torch and the workpiece
10 037	**non-transferred arc**	arc established between the electrode and the constricting nozzle of the plasma arc torch or thermal spraying gun *NOTE The workpiece does not form part of the electrical circuit.*
10 038	**electrode pick-up**	contamination of a non-consumable electrode by metal or scale from the surface of the workpiece
10 040	**pick-up**	1) *In fusion welding*, transfer of alloying elements from the parent metal to the weld metal as a result of dilution 2) *In resistance welding*, particles of the surface of the workpiece that adhere to the surface of the electrodes, or vice versa
10 041	**arc eye**	irritation of the eye caused by exposure to radiation from an electric arc
10 042	**electrode holder**	device to hold an electrode and to convey current to it *NOTE 1 In resistance welding, this is device holding a spot welding electrode.* *NOTE 2 In arc welding, this is a tool for clamping, guiding and connecting a covered electrode to the welding circuit while insulating the operator from the welding*
10 043	**welding glass** filter glass	special filter that provides protection against glare when welding and in addition reduces the UV radiation and IR radiation that is dangerous to the human eye
10 044	**heat filter**	colourless, transparent, heat-absorbing glass plate placed between the plain glass and the welding glass to protect the eyes *NOTE It is usually used in high current metal inert-gas welding.*
10 045	**blowpipe** torch: *deprecated*	device for mixing and burning gases to produce a flame for welding, brazing, braze welding, cutting, heating and similar operations (See also terms 32 142 to 32 144.)
10 046	**flashback**	retrogression of the flame beyond the blowpipe body into the hose, with possible subsequent explosion
10 047	**pressure regulator** gas regulator	device for attachment to a gas cylinder or pipeline for reducing and regulating the gas pressure to the working pressure required
10 048	**residual welding stress**	stress remaining in a metal part or structure as a result of welding
10 050	**pulse**	unidirectional flow of current of either polarity of brief duration
10 051	**pulse time**	duration of a pulse

No.	Term	Definition
10 052	**welding primer** weldable primer: *deprecated*	paint that is applied to a shot-blasted metal surface for protective purposes, which does not have to be removed prior to welding and does not prevent the making of a satisfactory weld
10 053	**welding consumables**	all materials, such as filler materials, gas, flux or paste, used up during welding and enabling or facilitating the formation of a weld
10 054	**welding equipment**	basic apparatus used in welding such as power source, as well as wire feeder and powder feeder, etc.
10 055	**welding accessories**	all items of welding equipment associated with welding, other than welding plant and welding consumables
10 056	**layer**	stratum of weld metal consisting of one or more runs, side by side
10 057	**building-up**	overlay welding to obtain or restore required dimensions
10 058	**surfacing**	producing a layer of metal, by welding, on a workpiece to obtain desired properties or dimensions
10 060	**joint preparation** weld preparation	preparation for making a connection where the individual components, suitably prepared and assembled, are joined by welding or brazing
10 061	**joint**	junction of workpieces or the edges of workpieces that are to be joined or have been joined
10 063	**air gap** gap	1) *In fusion welding*, minimum distance at any cross-section between edges, ends or surfaces to be joined 2) *In magnetically-impelled arc butt welding*, space between component surfaces across which the arc is maintained during the heating (arcing) period
10 064	**heat input**	heat introduced into the joint during welding, referred to a characteristic dimension, such as a bead or weld length, weld cross-section, weld spot diameter
10 066	**acceptance criteria**	specified quality criteria for defining conformance of a weld
10 067	**acceptance level**	specific set of acceptance criteria where more than one set can be selected
10 068	**examiner**	person who has been appointed to verify compliance with the applicable standard *NOTE In certain cases, an external independent examiner can be required.*
10 069	**examining body**	organization that has been appointed to verify compliance with the applicable standard *NOTE In certain cases, an external independent examining body can be required.*
10 070	**welding procedure specification** **WPS**	document that has been qualified and provides the required variables of the welding procedure to ensure repeatability during production welding
10 071	**welding procedure qualification record** **WPQR**	record comprising all necessary data needed for qualification of a preliminary welding procedure specification
10 073	**welding variable**	variable which influences the characteristics of the welded joint

No.	Term	Definition
10 074	**essential variable**	welding condition that requires qualification
10 075	**additional variable non-essential variable**	welding condition addressed in the welding procedure specification but not requiring qualification
10 076	**standard material**	material produced and delivered in accordance with a standard or specification
10 080	**re-start**	point on the run where the welding is or was re-started
10 081	**post-weld heat treatment**	application of heat to an assembly after welding, brazing, soldering, thermal spraying or cutting
10 082	**plasma gas**	ionized gas that generally forms the major portion of an arc column and provides a conducting path for the current
10 083	**preheat**	heating of an appropriate area of a workpiece before welding, normally to achieve the preheating temperature
10 084	**cooling rate**	rate of decrease of temperature with time over a specified temperature range or time
10 085	**heating rate**	rate of increase of temperature with time over a specified temperature range or time
10 088	**dissimilar material joint**	welded joint in which the parent materials have significant differences in mechanical properties and/or chemical composition
10 089	**as welded**	pertaining to the condition of weld metal, welded joints, and weldments after welding, but prior to any subsequent thermal, mechanical, or chemical treatments *NOTE For alloys that may undergo natural ageing (e.g. some aluminium alloys) the as-welded condition lasts only for a limited period of time.*
10 090	**auxiliary material**	welding consumable used during welding, generally not forming part of the finished weld
10 091	**quality level**	description of the qualities of a weld on the basis of type, size and amount of selected imperfections
10 092	**fitness-for-purpose**	ability of a product, process or service to serve a defined purpose under specific conditions
10 093	**side edge of workpiece**	edge of workpiece, transverse to weld surface (see Figure 5, item 2) *NOTE Illustration from BS EN ISO 17659.*

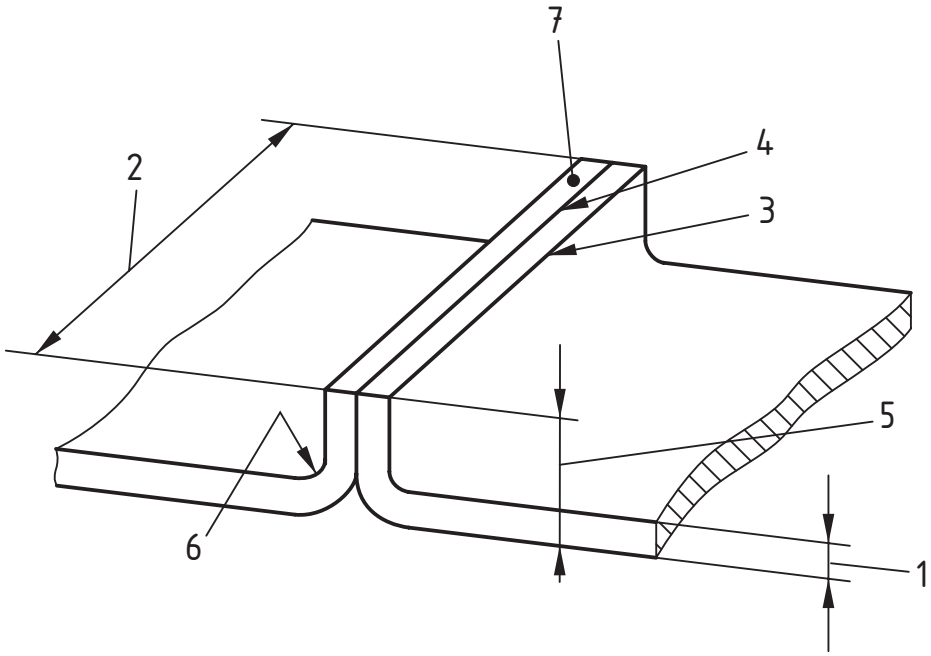
Figure 5 **Preparation for square butt weld**



Key

1 Plate thickness
2 Side edge of workpiece
3 Gap
4 Joint length
5 Upper workpiece surface
6 Reverse side
7 Plate edge
8 Fusion face (unprepared)

Figure 6 **Preparation for butt weld between plates with raised edges**



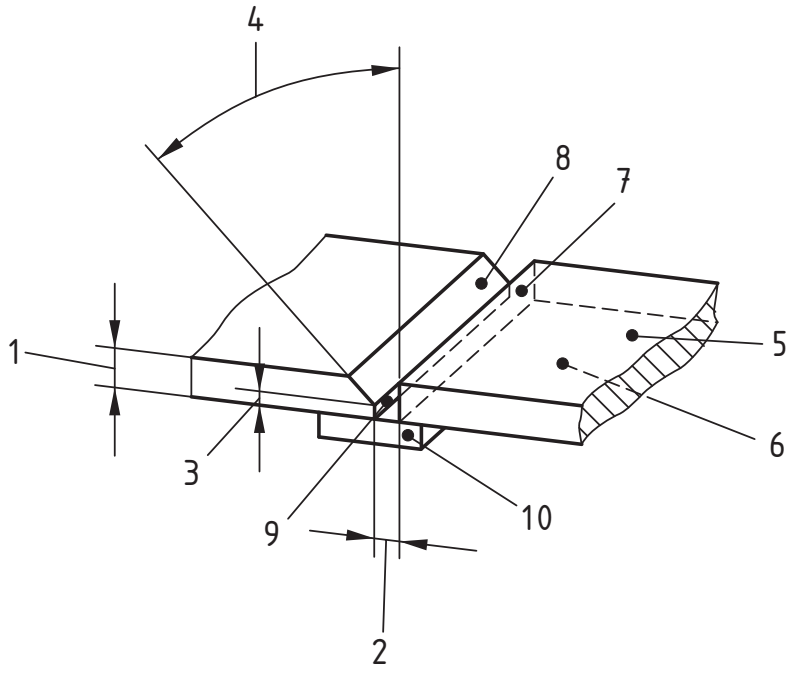
Key

1 Plate thickness
2 Length of raised edge
3 Longitudinal side of raised edge
4 Abutment of raised edge
5 Depth of raised edge
6 Radius of raised edge
7 Fusion face (unprepared)

No.	Term	Definition
10 094	**abutment of raised edge**	contact surface of a raised-edge joint (see Figure 6, item 4) *NOTE Illustration from BS EN ISO 17659.*
10 095	**homogeneous joint**	welded joint in which the weld metal and parent material have no significant differences in mechanical properties and/or chemical composition *NOTE A welded joint made of similar parent materials without filler metal is considered homogeneous.*
10 097	**plate edge**	edge of a plate, normal to the joint axis (see Figure 5, item 7) *NOTE Illustration from BS EN ISO 17659.*
10 098	**manufacturing organization**	workshop or site or both which is/are under the same technical and quality management
10 099	**welding co-ordinator**	qualified person who has responsibilities in the manufacturing operation for carrying out one or more co-ordination tasks for welding or welding related matters, e.g. planning, controlling, supervising, monitoring, and whose competence and knowledge has been demonstrated by training, education and/or relevant manufacturing experience
10 100	**high pressure blowpipe**	blowpipe in which the pressure of both the fuel gas and the oxygen/compressed air, measured immediately before the point of mixing, is higher than the pressure of the mixture, measured between point of mixing and welding nozzle
10 101	**low pressure blowpipe**	blowpipe in which the fuel gas pressure, measured immediately before the mixing chamber, is lower than the pressure of the gas mixture, measured between the mixing chamber and welding nozzle
10 102	**edge distance**	distance between the centre of a weld and the nearest edge of the workpiece
10 103	**range of qualification**	extent of qualification for an essential welding variable
10 104	**batch sample**	one or more units of product selected at random from the batch and considered to be representative of the batch
10 105	**plate thickness**	See Figures 5, 6, 7, 8, 9, and 10. *NOTE Illustrations from BS EN ISO 17659.*
10 106	**nominal thickness**	specified thickness, excluding any permitted tolerances
10 108	**welding procedure test**	making and testing of a representative welded joint, in order to prove the feasibility of a welding procedure *NOTE 1 This term is not usually applied to any tests that may have been made during the development of a welding procedure.* *NOTE 2 Sometimes an additional joint of a different type is welded in order to obtain relevant test data.*
10 109	**function test**	test of a welding unit set-up in accordance with a welding procedure specification (WPS)
10 110	**production test**	welding test carried out in the production environment on the welding unit, on actual products or on simplified test pieces, during an interruption of normal production
10 111	**pre-production welding test**	welding test having the same function as a welding procedure test, but based on a non-standard test piece representative of the production conditions

No.	Term	Definition
10 112	**production sample testing**	testing of actual welded products sampled from a continuous production
10 113	**manufacturer's previous welding experience**	practice authenticated by test data demonstrating that established production welding procedures have been capable of consistently producing welds of acceptable quality over a period of time
10 114	**upper workpiece surface**	normally the side of the joint accessible for the commencement of welding (see Figure 5, item 5, and Figure 7, item 5). *NOTE Illustrations from BS EN ISO 17659.*
10 115	**reverse side**	side of the joint opposite to the upper workpiece surface (see Figure 5, item 6, and Figure 7, item 6). *NOTE Illustrations from BS EN ISO 17659.*

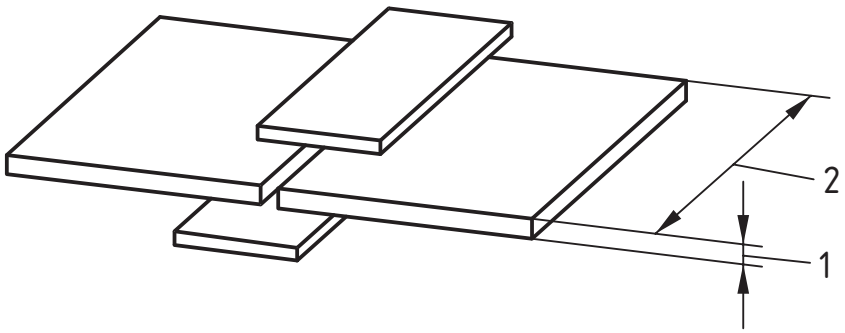
Figure 7 **Preparation for single bevel butt weld with backing**



Key

1 Plate thickness
2 Root gap
3 Depth of root face
4 Included angle
5 Upper workpiece surface
6 Reverse side
7 Fusion face (unprepared)
8 Fusion face (prepared)
9 Root face
10 Weld pool backing

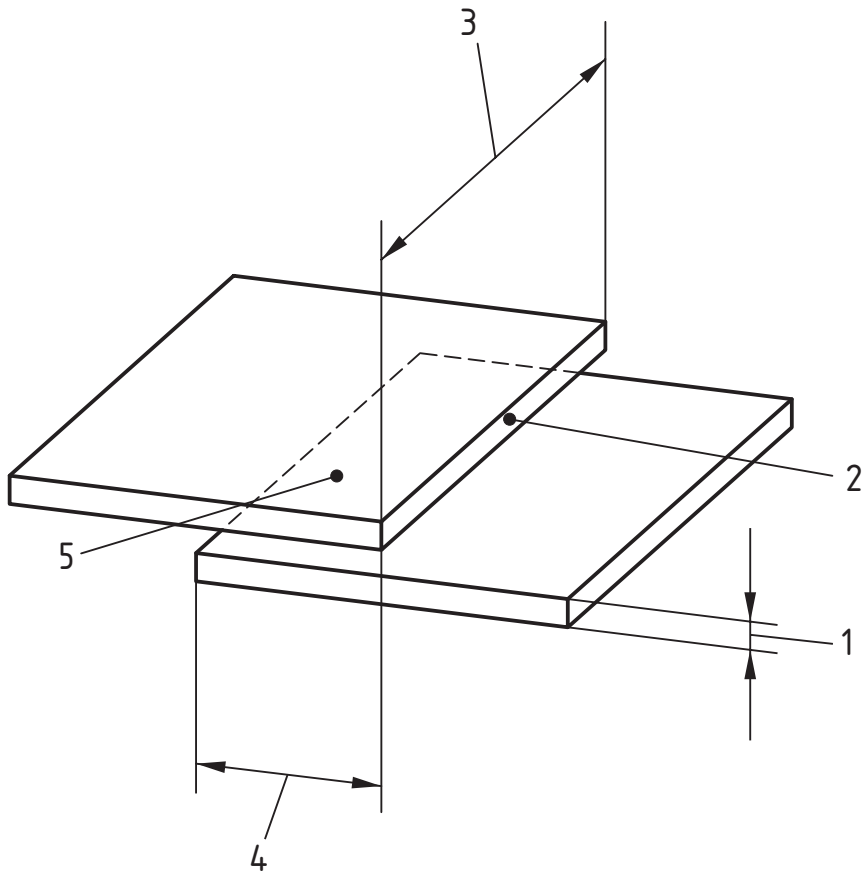
Figure 8 **Configuration for double-covered lap joint**



Key
1 Plate thickness 2 Workpiece width

No.	Term	Definition
10 116	**slope**	*in welding geometry*, angle between the root line and the positive x-axis of the horizontal reference plane in straight welds
10 117	**ferrite number**	arbitrary number indicating magnetic attraction relative to a series of reference samples and therefore proportional to the ferro-magnetic phase content
10 118	**work instruction**	simplified specification of the welding procedure, suitable for direct application in the workshop
10 119	**weld interface**	contact area after the welding force is applied
10 120	**workpiece width**	width of the workpiece, parallel to the weld surface (see Figure 8, item 2) *NOTE Illustration from BS EN ISO 17659.*
10 121	**lap width**	dimension of overlap, transverse to the joint line (see Figure 9, item 4) *NOTE Illustration from BS EN ISO 17659.*
10 122	**weld length**	overall length of continuous deposited weld metal in a joint *NOTE Illustration from BS EN ISO 17659.*

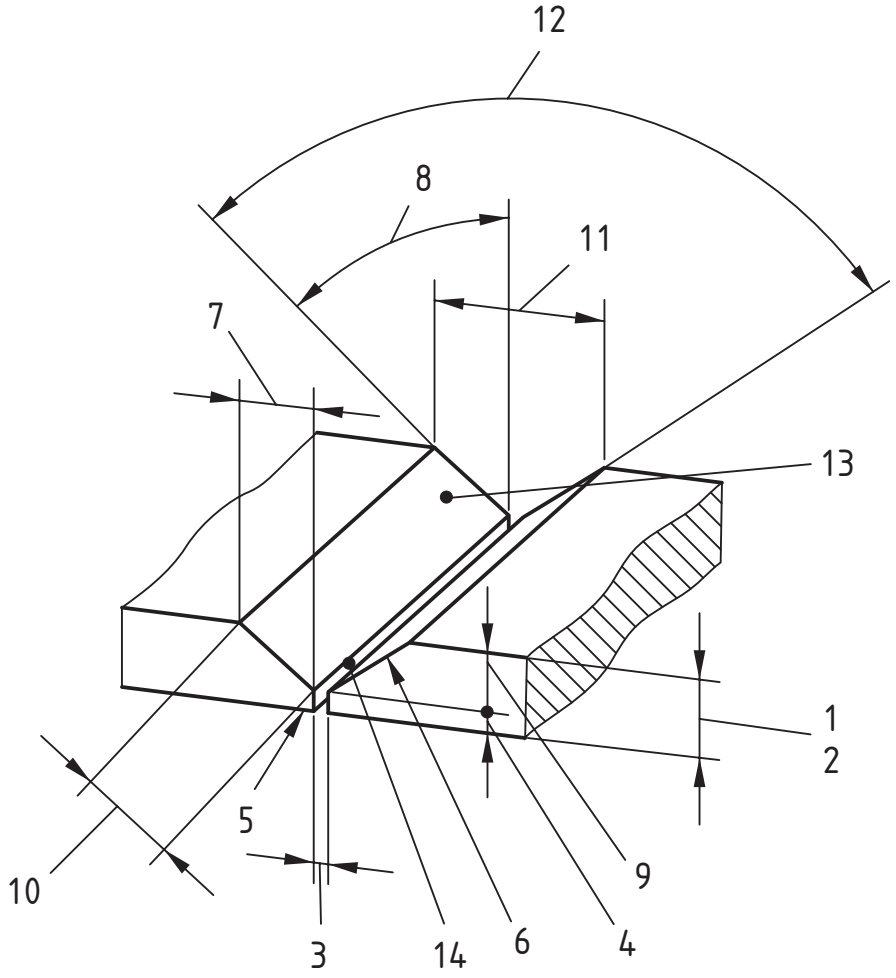
Figure 9 **Configuration for single lapped joint**



Key

1 Plate thickness
2 Side of lap face
3 Lap length
4 Lap width
5 Lapped area

Figure 10 **Preparation for single V-butt weld**



Key

1 Plate thickness	5 Side edge of preparation	9 Width of prepared face
2 Root gap	6 Width of preparation	10 Included angle
3 Depth of root face	7 Angle of bevel	11 Fusion face (prepared)
4 Side edge of root face	8 Depth of preparation	12 Root face

No.	Term	Definition
10 123	**lap length**	length of lap, parallel to the joint line (see Figure 9, item 3) *NOTE Illustration from BS EN ISO 17659.*
10 124	**joint length**	dimension of joint in the direction of the weld axis (see Figure 5, item 4, Figure 63, item 3, and Figure 65, item 2) *NOTE Illustrations from BS EN ISO 17659.*
10 125	**batch**	collection of one or more units of products, made in a single production run
10 126	**parent material**	material to be joined, or surfaced, by welding, braze welding or brazing
10 127	**contracting parties**	parties who have entered into a supply contract

No.	Term	Definition
10 128	**welding co-ordination personnel**	personnel who have responsibilities in the manufacturing operation for welding and welding related activities whose competence and knowledge have been demonstrated by, e.g. training, education and/or relevant manufacturing experience
10 129	**corrosion resistant surfacing**	adherent material for protection of a surface against corrosion
10 130	**heat resistant surfacing**	adherent material for protection of a surface against heat
10 131	**overlap**	*in a lap joint*, minimum distance between the edges of overlap plates *in beam welding*, portion of the weld pass remelted prior to the slope down *in seam welding*, area in the preceding weld remelted by the succeeding weld
10 132	**rotation**	*in welding geometry*, angle between the centreline of a weld and the positive y-axis or a line parallel to the y-axis, measured in the counter-clockwise direction in the plane of the transverse cross-section of the weld
10 133	**production welding**	welding carried out during manufacture before final delivery to the end user
10 134	**robotic welding**	automatic welding using a robot that can be preprogrammed to different welding paths and fabrication geometries
10 135	**fully mechanized welding**	welding where all the main operations (excluding the handling of the workpiece) are mechanized *NOTE Manual adjustment of welding variables during welding is possible.*
10 136	**lapped area**	area of overlapped material in a lapped joint (see Figure 9, item 5) *NOTE Illustration from BS EN ISO 17659.*
10 137	**preheat maintenance temperature**	minimum temperature in the weld zone which shall be maintained if welding is interrupted
10 138	**preheating temperature**	temperature immediately prior to the commencement of welding resulting from the heating of the parent metal in the region of the weld
10 140	**finishing welding**	welding carried out in order to remove casting defects and core openings to ensure the agreed quality of castings
10 142	**joint welding**	production welding used to join components together
10 143	**qualified person**	person whose competence and knowledge have been obtained by education, training and/or relevant experience *NOTE In order to demonstrate the level of competence and knowledge a qualification test may be required.*
10 144	**heterogeneous joint**	welded joint in which the weld metal and parent material have significant differences in mechanical properties and/or chemical composition
10 145	**productive welding time**	time during which the welding operation takes place
10 146	**welding conditions**	conditions under which welds are made; these include environmental factors (e.g. weather), stress and ergonomic factors (e.g. noise, heat, cramped working conditions) and workpiece-related factors (e.g. parent metal, groove shape, working position)

No.	Term	Definition
10 147	**welding parameters**	information needed for the performance of welding with a specified welding procedure *NOTE Welding parameters are, e.g. welding consumables, parent material, joint preparation, welding current, welding voltage, travel speed, preheating, working and interpass temperature and run sequence.*
10 148	**welding sequence schedule**	schedule specifying the order and direction in which welds are to be made on a workpiece
10 149	**welding time**	time required for making a weld (excluding preparatory or finishing operations) *NOTE It consists of productive welding time and the servicing time.*
10 150	**joint efficiency**	ratio of strength of a joint to the strength of the parent metal, expressed as a percentage
10 151	**faying surface** interface: *deprecated*	1) surface of one component that is intended to be in contact with a surface of another component to form a joint 2) *in friction welding*, contact area developed between the workpieces after completion of the welding operation
10 152	**stud**	fastener to be attached by stud welding
10 153	**protrusion**	*in stud welding*, distance between the tip of the stud and the face of the support device in their initial position
10 154	**lift**	*in stud welding*, distance between the stud tip and the workpiece surface with the stud-lifting mechanism in position and activated
10 155	**semi-automatic welding** partly mechanized welding	welding in which some of the welding parameters, such as arc length, are automatically controlled, but manual guidance is necessary
10 156	**shop weld**	weld made within the premises of the manufacturer of the welded assembly
10 157	**site weld**	weld made at the location where the assembly is to be installed
10 158	**covered filler rod** coated filler rod: *deprecated*	filler rod having a covering of flux
10 159	**fusion boundary** **weld junction** fusion line	boundary between the fusion zone and the heat-affected zone (See Figure 4.)
10 160	**approved welding procedure**	documented welding procedure that has been approved by such means as an inspecting authority either by means of a welding procedure test or authentic documented experience gained with the welding of joints similar to that to which the welding procedure applies, or other approved methods
10 161	**three-phase welding power source** three-phase welding machine	welding power source in which power is taken from all three phases of a three-phase supply to provide a single welding current or three single-phase welding currents
10 162	**idling time**	time during which energy is available for welding but is not being used

No.	Term	Definition
10 163	**recovery time**	time required, after a change of conditions has occurred in a welding circuit, for either the current or the voltage, or both, to recover to a specific percentage of their value before the change
10 164	**cycle**	arbitrary unit of time, of duration equal to that of one cycle of the alternating current supply *NOTE Normally in the UK this is 1/50 s*
10 165	**nozzle-constricted arc**	arc that is constricted or shaped by the nozzle walls
10 166	**vortex-constricted arc**	arc that is constricted by a vortex produced by swirling liquid or gas
10 167	**transferred arc**	constricted arc that is struck between an electrode mounted within a torch and the workpiece
10 168	**non-transferred arc**	constricted arc that is struck between an electrode within a torch and a second electrode which forms a nozzle through which the plasma flows
10 169	**partially transferred arc**	constricted arc formed when the workpiece is connected to one terminal of the power supply and the other terminal is connected to an electrode within the torch; the torch nozzle also forms part of the electrical circuit and is at an intermediate potential
10 170	**sleeve joint**	joint where the ends of two pipes or round bars fit into a short length of pipe, the inside diameter of which approximates to the outside diameter of the two other members
10 171	**fixed shield**	independently mounted device to provide protection from injury during welding or cutting
10 172	**plain glass** cover glass	clear glass or other transparent material used to protect the surface of welding glass from spatter
10 173	**welding spectacles**	spectacles fitted with welding glass, normally issued to persons whose duties require them to work in the vicinity of welding or cutting operations
10 174	**welding goggles**	protective device enclosing a space in front of the eyes to shield them from injury during welding or cutting, fitted with welding glass and plain glass
10 175	**chipping goggles**	protective device enclosing a space in front of the eyes to shield them from injury during chipping, grinding or cutting, fitted with plain glass
10 176	**face mask**	1) protective device worn in front of the face to shield it from injury during welding or cutting, fitted with welding glass and plain glass 2) protective device supplied with fresh air and worn over the nose and mouth
10 177	**helmet** head screen head shield	protective device supported on the head and arranged to shield the face and throat from injury during welding, fitted with a window consisting of welding glass and plain glass, and if necessary a heat filter
10 178	**welding gloves**	gloves to protect the hands, or gauntlets to protect the hands and forearms, from heat and metal splashes due to welding or cutting

No.	Term	Definition
10 179	**open injector-mixer** bunsen-type mixer	injector-mixer where the additional gas is drawn in from the atmosphere
10 180	**closed injector- mixer**	injector-mixer that is closed to the atmosphere, the entrained gas being drawn up through a tube connected to the unit
10 181	**cone**	more luminous part of a flame, which is adjacent to the nozzle orifice
10 182	**feather**	carbon-rich zone, visible in a flame, extending around and beyond the cone when there is an excess of carbonaceous gas
10 183	**gas envelope**	gas surrounding the inner cone of an oxy-fuel gas flame
10 184	**threaded hose connection**	threaded part (inlet or outlet) of a welding or cutting appliance to which a fitted hose is coupled *NOTE Threaded hose connections, hose coupling nuts and hose couplers have right-hand threads for non-combustible gases and left-hand threads for combustible gases. Hose coupling nuts and hose couplers having left-hand threads are notched.*
10 185	**hose coupling nut** union nut: *deprecated*	nut used for securing the hose coupling nipple to a threaded hose connection or to a hose coupler (See note to term 10 184.)
10 186	**hose coupling nipple**	metal component, one end of which is inserted into a hose, the other end has a seating and a shoulder around which can be rotated the hose coupling nut (See note to term 10 184.)
10 187	**fitted hose**	length of hose at each end of which is a hose coupling nipple and a hose coupling nut
10 188	**hose coupler**	component, consisting of a hexagonal centre portion with threaded ends, for connecting two lengths of fitted hose (See note to term 10 184.)
10 189	**flame snap-out**	unintentional extinction of the flame outside the nozzle orifice
10 190	**gas economizer**	auxiliary device designed for temporarily cutting off the supply of gas to the welding equipment, except the supply to a pilot jet where fitted
10 191	**two-stage regulator**	gas regulator in which the gas pressure is reduced to the working pressure in two stages
10 192	**manifold regulator** **multi-stage regulator**	gas regulator in which the gas pressure is reduced to the working pressure in more than one stage
10 193	**flame arrestor** **flashback arrester**	safety device fitted in a fuel gas system to prevent any flashback reaching the fuel gas pipeline or supply
10 194	**hydraulic back pressure valve**	water-charged non-return safety valve fitted in an acetylene gas system to prevent flashback or back pressure from the blowpipe reaching the acetylene generator
10 195	**flame normalizing**	normalizing carried out by direct flame heating
10 196	**interpulse time**	period of time between successive pulses during the making of a single weld
10 197	**welding cycle** **welding cycle time**	period required to complete a welding cycle
10 198	**weld timer**	device that controls only the weld time

No.	Term	Definition
10 199	**welding rectifier** **welding convertor** **rectifier converter**	device that converts single or multiphase power from the frequency of the power supply to unidirectional current
10 200	**stored-energy welding**	method of welding in which the welding energy is stored in an inductor, a capacitor, an electric accumulator or a flywheel during a period of time relatively long compared to the welding time
10 201	**burnt weld**	weld in which the weld metal has been grossly overheated causing excessive oxidizing thereby reducing the strength of the joint
10 202	**weldability**	ease with which a material or materials can be welded to give an acceptable joint
10 203	**plasma arc**	transferred arc in which a constriction (mechanical or magnetic) is used to produce a thin pencil-like configuration of plasma and electrons to give a high heat concentration over a small area
10 204	**plasma jet**	jet or plasma formed by a non-transferred arc and expelled through an orifice at high velocity by gas pressure
10 205	**plasma weld surfacing**	surfacing or cladding in which the heat is provided by a plasma arc that may be transferred or partially transferred to the workpiece *NOTE The cladding material may be applied as powder or as filler wire that is fused to the parent metal.*
10 206	**nozzle** tip: *deprecated*	generally detachable part of a blowpipe from which gas or gases emerge
10 207	**blowpipe head**	part of a blowpipe to which a nozzle is fitted
10 208	**blowpipe shank**	part of a blowpipe that is normally held or gripped, to which are fixed the valves and threaded hose connections
10 209	**combined blowpipe** combined outfit: *deprecated* combined set: *deprecated*	blowpipe that, when fitted with the appropriate attachments, can be used for welding, cutting, heating or flame cleaning
10 210	**head mixing blowpipe**	blowpipe with a mixer or injector-mixer in the head
10 211	**harsh flame**	flame in which the velocity of the gases is higher than normal
10 212	**soft flame**	flame in which the velocity of the gases is lower than normal
10 213	**dissolved acetylene**	acetylene made stable under pressure by being dissolved in a liquid, e.g. acetone
10 214	**groove weld**	weld in a preparation made to receive weld metal
10 215	**roll welding**	welding with pressure in which a force is progressively applied by mechanically operated rolls after heating by different means
10 216	**robot**	programmable, multi-function manipulator
10 217	**manipulation**	operation of grasping and moving an object
10 218	**adaptive control system** feedback control system	control method in which control parameters are continuously and automatically adjusted in response to measured process variables to achieve the specified performance

No.	Term	Definition
10 219	**joint recognition**	form of adaptive control that recognizes variations in the geometry detects changes in the joint geometry and instructs the welding machine to take the appropriate corrective action
10 220	**weld recognition** weld feature recognition	form of adaptive control that recognizes variations in the geometry (including penetration depth) of the weld or weld pool being made and instructs the welding machine to take the appropriate corrective action
10 221	**joint tracking** seam tracking	form of adaptive control that monitors changes in the location of the joint to be welded and instructs the welding machine to take the appropriate corrective action
10 222	**forehand welding**	welding technique in which the welding torch or gun is pointed in the direction of welding
10 223	**backhand welding**	welding technique in which the welding torch or gun is pointed towards the completed weld, i.e. opposite to the direction of welding

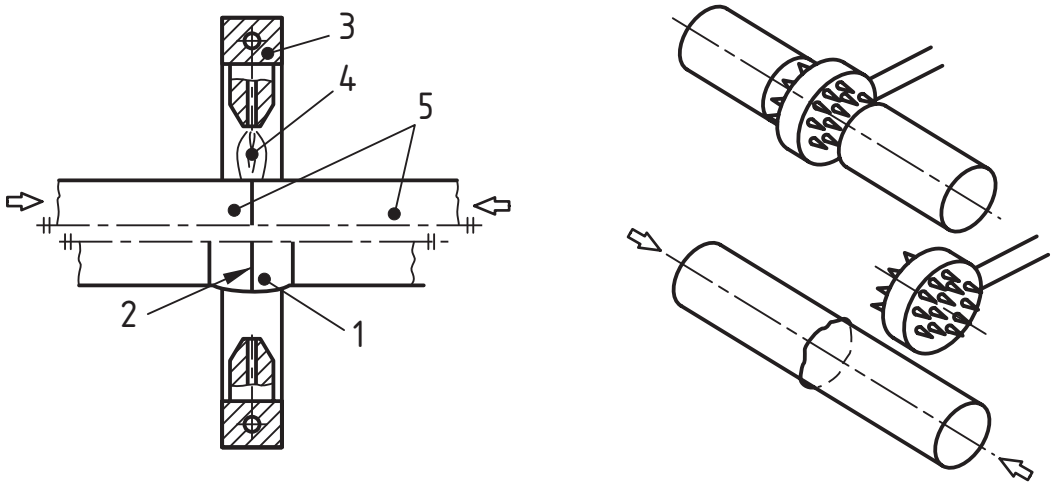
Section 2. Terms relating to welding with pressure

Subsection 21. Terms relating to more than one subsection

No.	Term	Definition
21 001	**welding with pressure**	welding in which sufficient outer force is applied to cause more or less plastic deformation of both the faying surfaces, generally without the addition of filler metal *NOTE Usually, but not necessarily, the faying surfaces are heated in order to permit or to facilitate unifying.*
21 002	**interface**	contact area when the welding force is applied
21 003	**HF induction welding**	welding in which an alternating electric current of at least 10 kHz is induced in the work to produce heat which in association with a forging action produces a joint
21 004	**upset metal** upset	parent metal proud of the normal surfaces of the work as a result of forging or pressing
21 005	**upset allowance**	length allowed for the total shortening of both components due to upsetting
21 006	**upset speed**	rate of movement of the moving workpiece during upsetting
21 007	**welding cycle**	succession of operations effected by the machine for the making of a weld and the return to the initial position
21 008	**upset force**[1)]	force producing or tending to produce upset metal
21 010	**upset pressure**	pressure (force per unit area) resulting from the upset force
21 011	**total allowance**	*In pressure, resistance butt, flash or friction welding*, the length allowed, in preparation for welding, for the total shortening of both components due to all the operations that are actually used in the making of a weld
21 012	**upset length**	total actual shortening of both components due to the forging action in the making of a weld
21 013	**forging force** forge force	1) force applied normal to the faying surfaces to complete the weld 2) *In friction welding*, force applied normal to the faying surfaces at the time when relative movement between the components is ceasing or has ceased
21 015	**forging time** forge time	duration of application of the forging force
21 016	**dwell**	*in resistance welding*, maintain the electrode force after the cessation of current
21 017	**dwell time**	*in fusion welding*, time during which the energy source pauses at any point in each oscillation
21 020	**oxy-fuel gas pressure welding**	welding with pressure in which the workpieces are heated at the faying surfaces by an oxy-fuel gas flame and the weld is made by applying a force without addition of filler metal; the assembly may be of the open or closed type *NOTE This process is illustrated in Figure 11.*

[1)] Force is sometimes incorrectly referred to as pressure. See terms 21 013 to 21 020.

Figure 11 **Oxy-fuel gas pressure welding**



a) Closed assembly b) Opened assembly

Key

1 Upset
2 Weld
3 Welding blowpipe
4 Gas flame
5 Workpiece

No.	Term	Definition
21 021	**ultrasonic welding**	welding process in which mechanical vibrations of low amplitude superimposed on a static force, and usually at frequencies above the audible limit, make a weld between two surfaces to be joined at a temperature well below the melting point of the parent metal *NOTE Additional heat may or may not be applied.*
21 022	**diffusion welding**	welding with pressure whereby the workpieces are kept in contact under specified continual pressure and are heated either on their faying surfaces, or in their entirety at a defined temperature over a controlled time (accompanied by a figure) *NOTE This results in local plastic deformation and thereby intimate contact of the surfaces and diffusion of the atoms through the interface. This produces complete continuity of the material. The operation may take place in a vacuum, under a gas shield or in a fluid, preferably without the addition of a filler metal.*
21 023	**explosive cladding**	cladding by explosive welding (see 26 001)
21 024	**magnetically-impelled arc butt welding**	welding process in which the faying surfaces of the workpieces are heated by a short duration arc between them and then brought together by the application of a force, the arc being impelled along the joint line by magnetic fields *NOTE The arc current can be either constant or increased in steps.*
21 025	**upsetting**	1) operation of locally increasing the cross-sectional area of a workpiece by the application of a longitudinal force 2) final operation of butt or flash welding comprising the application of a force to the ends of the workpieces after heating to welding temperature

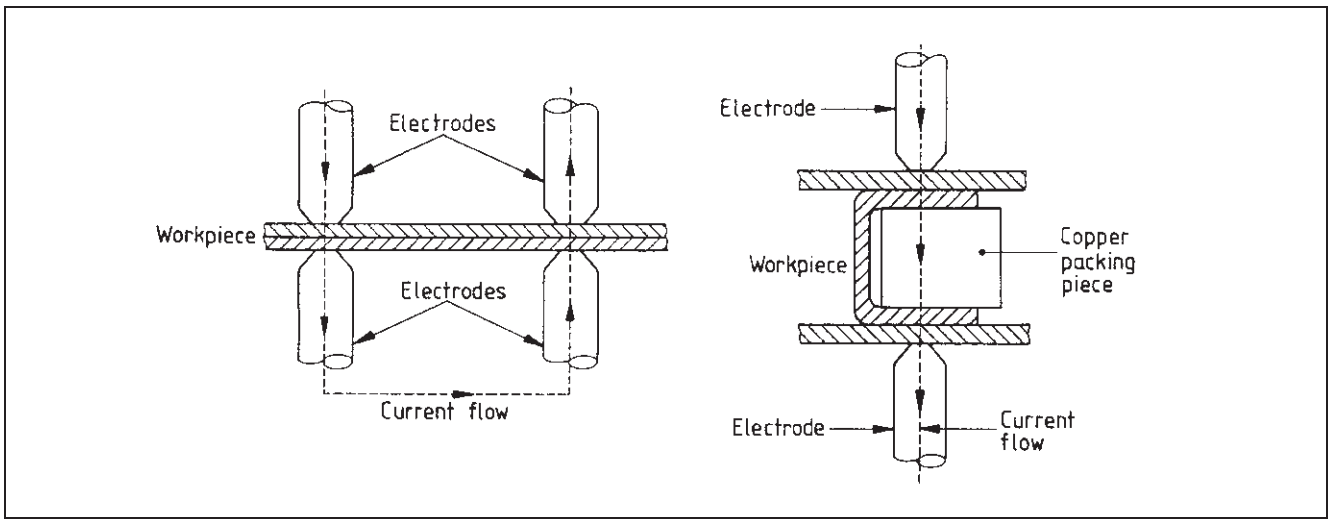
No.	Term	Definition
21 026	**pressure contact area**	initial surface contact area of the components through which force is transmitted
21 027	**forward force**[2)]	force applied to the movable head of a welding machine in the direction necessary to make a weld
21 028	**initial force**[2)]	first steady or peak force applied normal to the interface, during the welding cycle
21 029	**welding force**[2)] welding load: *deprecated*	force, at the abutting surfaces of a workpiece, used to make a weld
21 030	**post-weld upset force**[2)]	force required to reduce the workpiece to its correct length after welding
21 031	**post-heating force**[2)]	force applied by the electrodes to the work during the time post-heating current is flowing
21 032	**forward pressure**	pressure (force per unit area) resulting from the forward force
21 033	**initial pressure**	pressure (force per unit area) resulting from the initial force
21 034	**welding pressure**	pressure (force per unit area) resulting from the welding force
21 035	**post-weld upset pressure**	pressure (force per unit area) resulting from the post-weld upset force
21 036	**post-heating pressure**	pressure (force per unit area) resulting from the post-heating force
21 037	**overhang**	distance a component projects from the die or clamp in the direction of the mating component for resistance butt, flash, friction, pressure or magnetically impelled arc butt welding
21 038	**digital timer**	apparatus for controlling intervals of time by means of counting, to a preset number, pulses which have a constant rate of repetition
21 039	**analogue timer**	apparatus for controlling intervals of time that relies upon any time dependent physical change
21 040	**sequence timer**	apparatus comprising a group of timers for controlling various functions in a welding cycle in a predetermined sequence
21 041	**total loss**	*In pressure, resistance butt, flash, friction or magnetically impelled arc butt welding*, total amount of shortening of both components due to all the operations that are actually used in the making of a weld
21 042	**forge welding** fire welding	welding with pressure in which the workpieces are heated in air in a forge and the weld is made by applying blows or some other impulsive force sufficient to cause permanent deformation at the interfaces

[2)] Force is sometimes incorrectly referred to as pressure. See terms 21 032 to 21 036.

Subsection 22. Terms relating only to resistance welding

No.	Term	Definition
22 001	**resistance welding**	welding with pressure in which the heat necessary for welding is produced by resistance to an electrical current flowing through the welding zone
22 002	**resistance butt welding** slow butt welding: *deprecated* upset butt welding: *deprecated*	resistance welding in which the components are butted together under pressure, and current is allowed to flow until the temperature is reached at which upset metal is produced and the weld is completed
22 003	**flash welding** flash butt welding: *deprecated*	resistance welding during which heating is obtained when the workpieces are progressively and repeatedly advanced towards each other, causing the current to flow through localized points, thus creating flashing and expulsion of molten metal
22 004	**spot welding**	resistance welding in which a weld is produced at a spot in the work-piece between electrodes, the weld being of approximately the same area as the electrode tips, or as the smaller of tips of differing size; force is applied to the spot, usually through the electrodes, continuously throughout the process
22 005	**stitch welding**	spot welding in which successive welds overlap
22 006	**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
22 007	**series spot welding**	spot welding in which two or more welds are made simultaneously in electrical series (See Figure 12.)

Figure 12 **Examples of series spot welding**

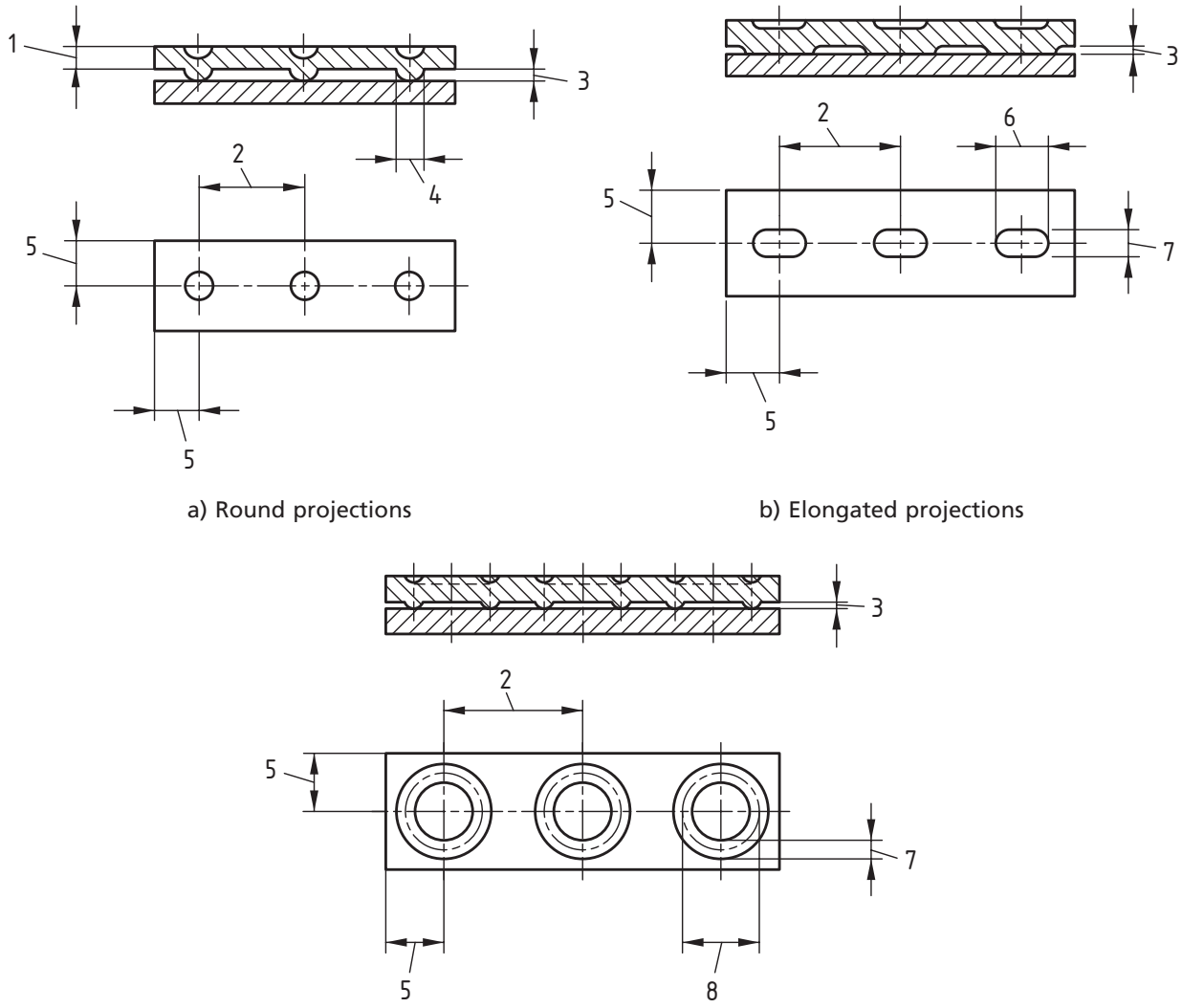


No.	Term	Definition
22 008	**seam welding**	resistance welding in which force is applied continuously and current continuously or intermittently to produce a linear weld, the workpiece being between two electrode wheels or between an electrode wheel and an electrode bar; the wheels apply the force and current and rotate continuously during the making of the linear weld
22 010	**projection welding**	resistance welding in which the force and current are localized by the use of a projection or projections raised on or formed from one or more of the faying surfaces, the projections collapsing during welding
22 011	**resistance stud welding**	stud welding using projection welding (See terms 10 032 and 22 010)
22 012	**percussion welding**	welding with pressure employing the heat from an arc produced by a rapid discharge of electrical energy; pressure is applied percussively during or immediately following the electrical discharge
22 013	**HF resistance welding**	resistance welding in which an alternating electric current of at least 10 kHz is fed through contacts to the work to provide the heat for welding; the high frequency current concentrates along adjacent surfaces to produce highly localized heat prior to the application of welding force
22 014	**cross-wire weld**	resistance weld at the point of contact between crossed wires or rods made with pressure applied continuously
22 015	**resistance welding electrode** electrode	replaceable portion of a resistance welding machine that transmits current and applies force to the pieces to be welded
22 016	**electrode shank**	portion of an electrode for spot or stitch welding intended to be held by, and to make electrical contact with, an electrode holder
22 017	**electrode wheel**	seam welding electrode in the form of a rotating disc
22 018	**flashing allowance**	length allowed for the total shortening of both components due to flashing, in preparation for flash welding
22 020	**electrode pressure**	pressure (force per unit of electrode contact area) resulting from the electrode force
22 021	**flashing time**[3)]	*In flash welding*, period of time between the start of continuous flashing and the time when the upset force is applied
22 022	**upset time**[3)]	duration of upset travel
22 023	**upset current time**[3)]	time during which upset current flows
22 024	**cool time**[3)] off-time	*In pulsation and seam welding*, period of time between two successive heat times in the same welding cycle
22 025	**weld time**[3)]	*In resistance welding*, duration of continuous flow of welding current
22 026	**hold time**[3)] dwell time	period of time between the cessation of current in a welding cycle and the cessation of electrode force
22 027	**welding current**	current (excluding preheating current) used to bring the workpiece to, and maintain it at, welding temperature

[3)] Attention is drawn to Figures 14 to 25 for diagrammatic representation of these terms.

No.	Term	Definition
22 028	**flashing current**	current flowing during flashing time
22 030	**flashing travel**	distance travelled by the moving head during flashing
22 031	**flashing speed**	rate of travel of the moving head during flashing
22 032	**throat depth** throat	*in resistance welding*, usable distance from the centre of the platens or the axes of the electrodes or, in the case of oblique electrodes, the point of intersection of the electrode axes in the working position or the contact line of electrode wheels and that part of the equipment body located closest to it
22 033	**throat gap**	1) *in spot and seam welding equipment*, usable distance between the arms or the outer current-conducting parts of the welding circuit 2) *in projection welding equipment*, clamping distance between the platens
22 034	**indirect spot welding**	spot welding in which only one electrode tip is used per weld; a backing electrode or the workpiece itself completes the electrical circuit and resists the force of the electrode tip
22 035	**forge delay time**	period of time between the start of weld time and the instant of application of maximum welding force
22 036	**backing electrode**	plate or strip of current-carrying material used in place of an electrode on one side of the work to reduce the marking for multi spot, seam or projection welds
22 037	**upset current**	current flowing during upsetting
22 038	**flashing loss**	*In flash welding*, total actual shortening of both components during the flashing time
22 040	**flashing**	*in flash welding*, phenomenon occurring as the components are progressively advanced towards each other, when the current, confined to localized points of contact, causes repeated expulsion of molten metal
22 041	**double-conductor connection cable**	cable comprising two conductors providing an electrical link between the secondary terminals of a resistance welding transformer and the welding set, and designed to have as low an electrical resistance as possible
22 042	**single-conductor connection cable**	cable comprising one conductor providing an electrical link between the secondary terminals of a resistance welding transformer and the welding set
22 043	**staggered resistance welds**	generally spot welds in two or more rows, in a staggered pattern (see Figure 14)
22 044	**projection diameter**	maximum diameter of individual projection [See Figure 13a), item 4] *NOTE Illustration from BS EN ISO 17659.*

Figure 13 **Forms of projection welds**



a) Round projections

b) Elongated projections

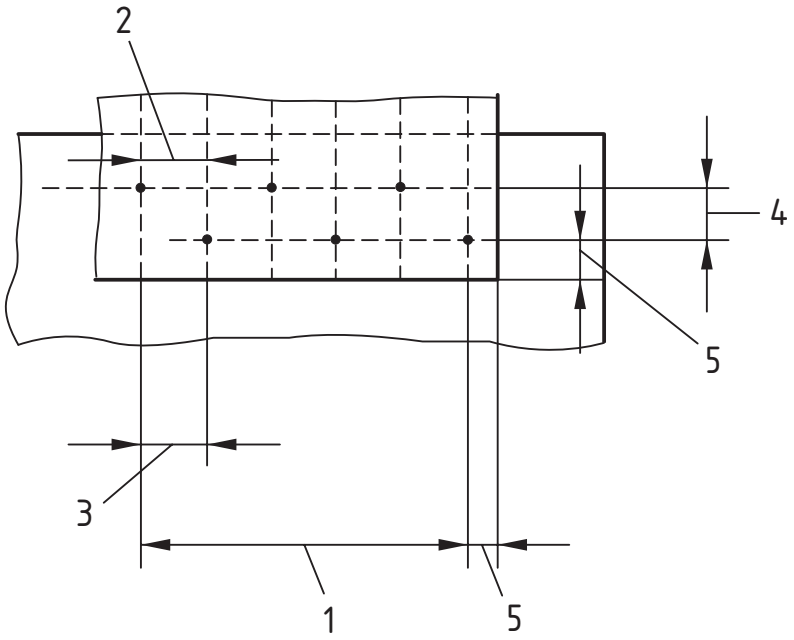
c) Annular projections

Key

1 Plate thickness
2 Pitch (of projections)
3 Projection height
4 Projection diameter
5 Edge distance
6 Projection length
7 Projection width
8 Annular projection diameter

No.	Term	Definition
22 045	**annular projection diameter**	mean diameter of an annular projection [See Figure 13c), item 8] *NOTE Illustration from BS EN ISO 17659.*
22 046	**nugget diameter**	*in resistance spot and projection welding*, mean of the minimum and maximum diameters of the fused zone measured at the interface omitting the corona bond area
22 047	**row pitch**	perpendicular distance between rows of spot welds, aligned parallel to the joint axis (see Figure 14, item 4) *NOTE Illustration from BS EN ISO 17659.*

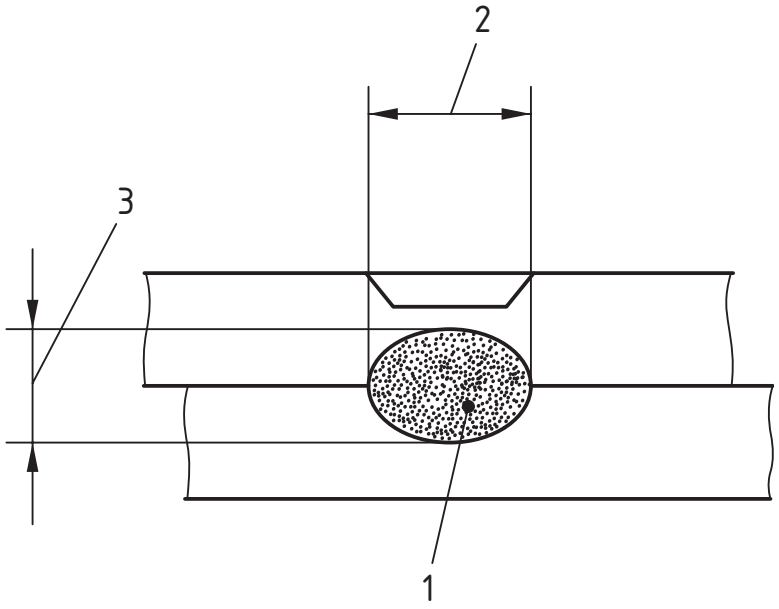
Figure 14 **Typical example of weld made using pressure – Double row of staggered, spaced spot welds**



Key

1 Weld length
2 Weld pitch
3 Stagger
4 Row pitch
5 Edge distance

Figure 15 **Typical example of weld made using pressure – Projection weld**

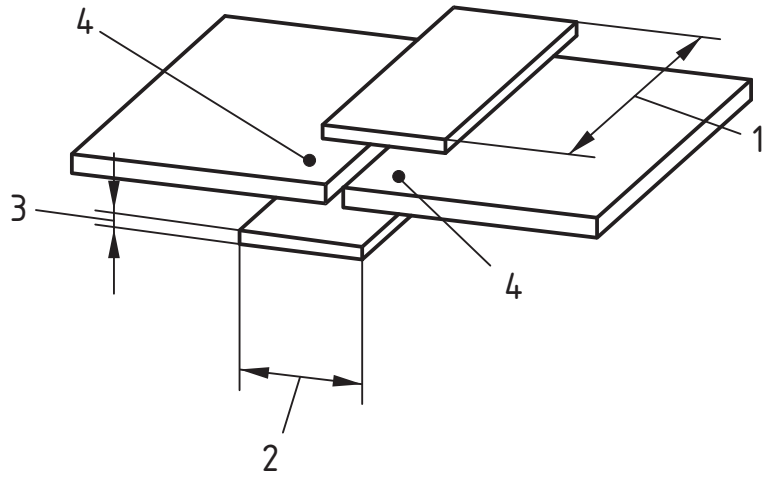


Key

1 Weld nugget
2 Nugget diameter
3 Nugget thickness

No.	Term	Definition
22 048	**pitch of projections**	distance between adjacent projection centres in a direction parallel to the joint line [see Figure 13a), item 2, Figure 13b), item 2, and Figure 13c), item 2]. *NOTE Illustration from BS EN ISO 17659.*
22 049	**weld pitch**	*In a double row of spot welds*, distance between adjacent weld centres in a direction parallel to the joint line *(same as "stagger"; see Figure 14, item 2)* *NOTE Illustration from BS EN ISO 17659.*
22 050	**foil thickness**	thickness of foil in a foil butt seam weld (see Figure 16, item 3) *NOTE Illustration from BS EN ISO 17659.*

Figure 16 **Foil butt-seam weld**



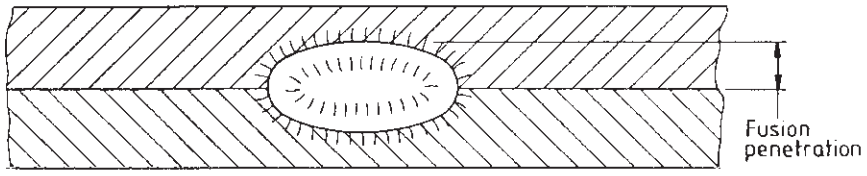
Key

1 Foil length
2 Foil width
3 Foil thickness
4 Foil contact surface

22 051	**nugget thickness**	maximum height of nugget in the thickness direction (see Figure 15, item 3) *NOTE Illustration from BS EN ISO 17659.*
22 052	**projection height**	height of projection prior to welding [see Figure 13a), item 3, Figure 13b), item 3, and Figure 13c), item 3] *NOTE Illustration from BS EN ISO 17659.*
22 053	**indentation**	depression on the exterior surface or surfaces of a spot or seam weld
22 054	**projection width**	*In elongated projections*, width of projection, transverse to the joint direction [see Figure 13b), item 7] *In annular projections*, difference between the inner and outer radius of an annular projection [see Figure 13c), item 7] *NOTE Illustration from BS EN ISO 17659.*
22 055	**foil width**	width of foil, measured transverse to the joint axis (see Figure 16, item 2) *NOTE Illustration from BS EN ISO 17659.*

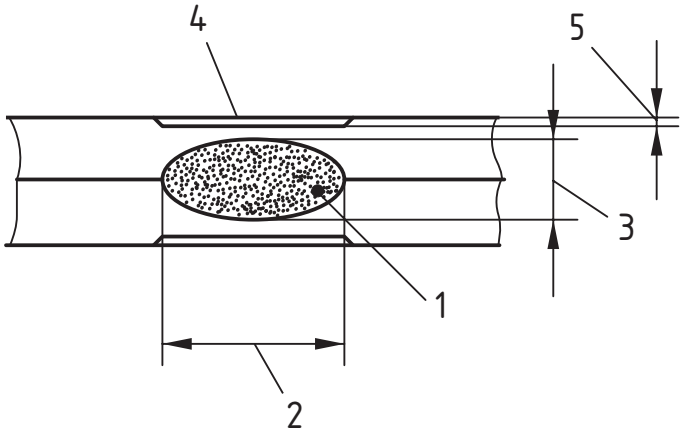
No.	Term	Definition
22 056	**projection length**	length of an elongated projection [see Figure 13b), item 6] *NOTE Illustration from BS EN ISO 17659.*
22 057	**foil length**	length of foil, parallel to the joint axis (see Figure 16, item 1) *NOTE Illustration from BS EN ISO 17659.*
22 058	**weld nugget**	zone in a spot, seam or projection weld where the metal has been melted (see Figure 17)

Figure 17 **Weld nugget**



No.	Term	Definition
22 059	**indentation depth**	depth of permanent indentation of joint surface produced by electrode after welding (see Figure 18, item 5) *NOTE Illustration from BS EN ISO 17659.*
22 060	**nugget overlap**	width of re-melting of nugget by adjacent nugget (see Figure 19, item 3) *NOTE Illustration from BS EN ISO 17659.*

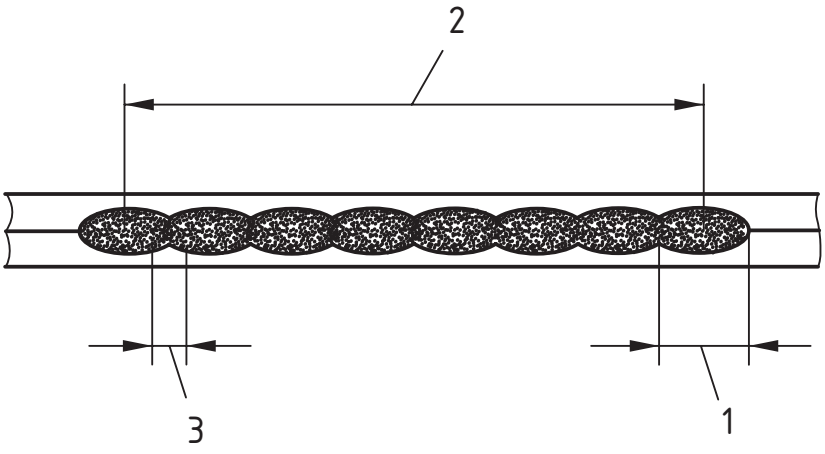
Figure 18 **Typical example of weld made using pressure – Resistance spot welds**



Key

1 Weld nugget
2 Nugget diameter
3 Nugget thickness
4 Indentation
5 Indentation depth

Figure 19 **Typical example of weld made using pressure – Seam weld**



Key
1 Nugget diameter
2 Weld length
3 Nugget overlap

No.	Term	Definition
22 061	**resistance weld setter**	*in resistance welding*, person who sets up mechanized or automatic welding
22 062	**foil contact surface**	contact surface between foil and workpiece (see Figure 16, item 4) *NOTE Illustration from BS EN ISO 17659.*
22 063	**mash seam weld**	seam or stitch weld, between two components of similar thickness, where the amount of overlap determines the width of weld, so made that the ultimate thickness of the workpiece at the weld approximates to that of one component (see Figure 20)
22 064	**nail head welding**	variant of heated nozzle welding in which the end of one or two wires which has been fed through the nozzle and heated by a flame or electric discharge, forms a small globule, which under the effect of the applied force is flattened into the shape of a nail head (see Figure 21)

Figure 20 **Mash weld**

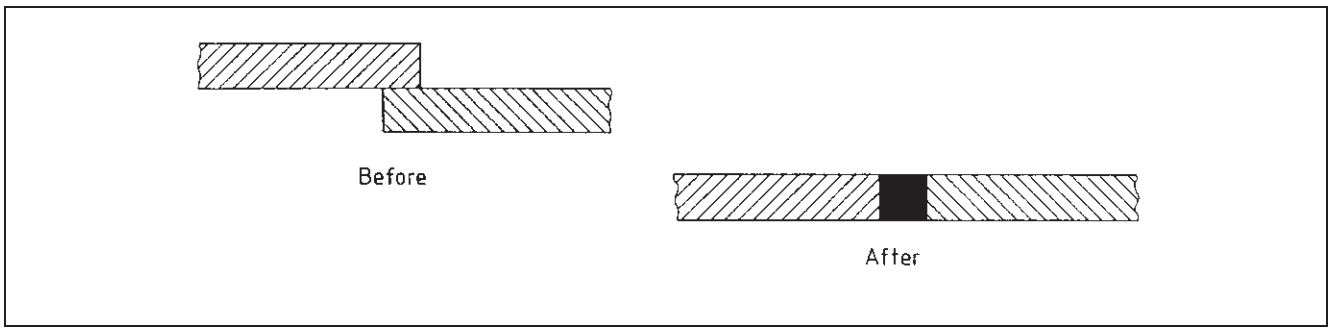
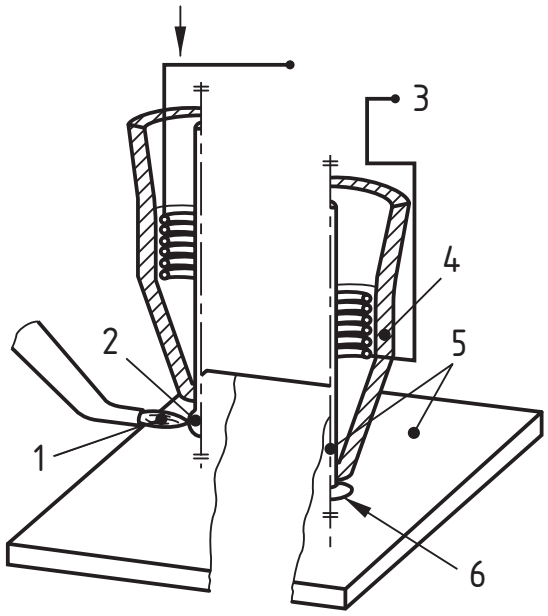


Figure 21 **Nail head welding**



Key

1 Flame
2 Molten metal globule
3 Power source
4 Nozzle
5 Workpiece
6 Weld

No.	Term	Definition
22 065	**straight flash welding**	flash welding technique in which flashing starts as soon as the workpieces are brought into contact and is maintained until upsetting takes place
22 066	**flash welding with preheating**	flash welding technique in which preheating current is applied to the workpieces to facilitate the onset of flashing
22 067	**roller spot welding**	spot welding in which force is applied continuously and current intermittently to produce a line of separate spot welds, the workpieces being between two electrode wheels or between an electrode wheel and an electrode bar; the wheels apply the force and current and rotate continuously while the line of welds is being made
22 068	**step-by-step roller spot welding**	spot welding in which force is applied continuously and current intermittently to produce a line of separate spot welds, the workpieces being between two electrode wheels or between an electrode wheel and an electrode bar; the wheels apply the force and current and are stationary during the normal flow of current and rotate when reduced or no current is flowing
22 069	**step-by-step seam welding**	resistance welding in which force is applied continuously and current intermittently to produce a linear weld, the workpiece being between two electrode wheels or between an electrode wheel and an electrode bar; the wheels apply the force and current and are stationary during the normal flow of current and rotate when reduced or no current is flowing

No.	Term	Definition
22 070	**step-by-step welding**	seam or roller spot welding in which the electrode wheel is stationary during the passage of weld current and rotates when reduced or no current is flowing
22 071	**butt-seam welding**	resistance welding applied progressively to a butt joint; electrodes press on the work on each side of the joint to pass current through it while welding force is generally applied by other means
22 072	**foil butt-seam welding** tape butt-seam welding	seam welding of two close square butted components with metal tape or wire placed or fed centrally to bridge one or both sides of the joint (see Figure 16)
22 073	**pulsation welding** woodpecker welding: *deprecated*	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
22 074	**half-cycle welding**	spot, projection or percussion welding in which the welding operation is completed in a whole or part of any one half cycle of the a.c. supply
22 075	**electrode tip**	surface of an electrode for spot or stitch welding intended to make contact with the workpiece
22 076	**vertical electrode**	electrode for spot or stitch welding in which the electrode tip is normal to the axis of the electrode shank
22 077	**angle electrode** inclined electrode	electrode for spot or stitch welding in which the electrode tip is not normal to the axis of the electrode shank
22 078	**offset electrode**	electrode for spot or stitch welding in which the electrode tip is not concentric with the axis of the electrode shank
22 079	**vertical centre electrode** straight electrode	vertical electrode where the electrode tip is concentric with the axis of the electrode shank (See Figure 22.)
22 080	**vertical offset electrode**	vertical electrode where the electrode tip is not concentric with the axis of the electrode shank (See Figure 23.)

Figure 22 **Vertical centre electrode**

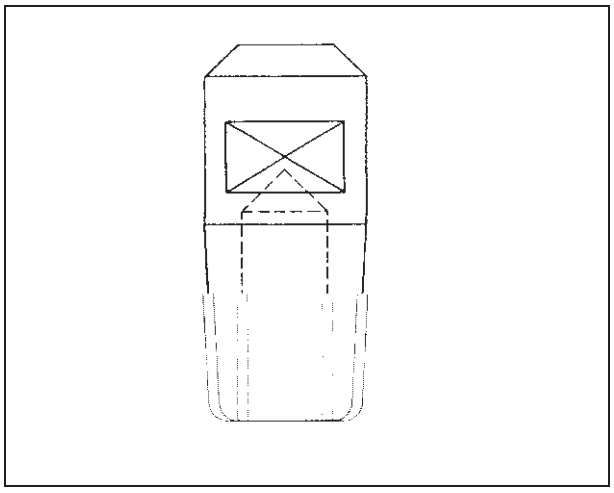
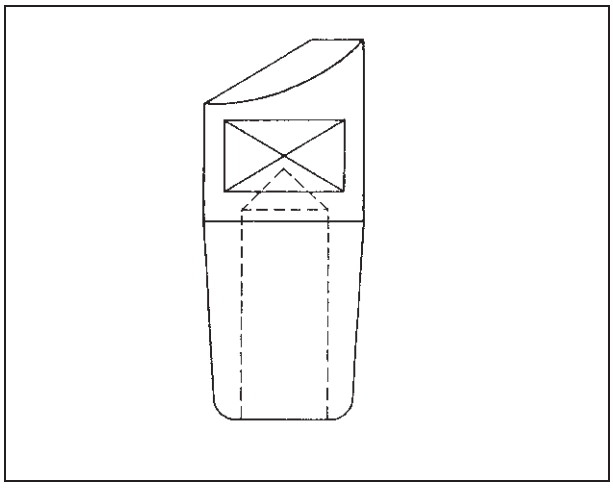


Figure 23 **Vertical offset electrode**



No.	Term	Definition
22 081	**angle offset electrode**	angle electrode in which the electrode tip is not concentric with the axis of the electrode shank (see Figure 24)
22 082	**cranked offset electrode** cranked electrode	offset electrode in which the centreline of the electrode is not straight (see Figure 25)

Figure 24 **Angle offset electrode**

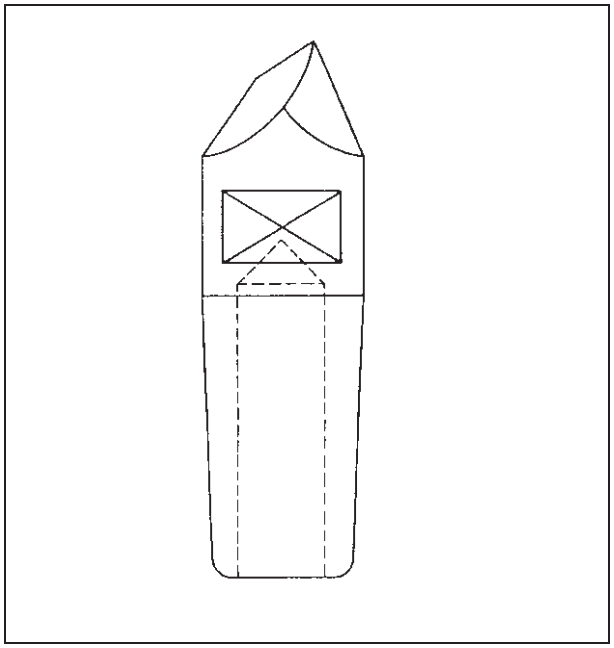
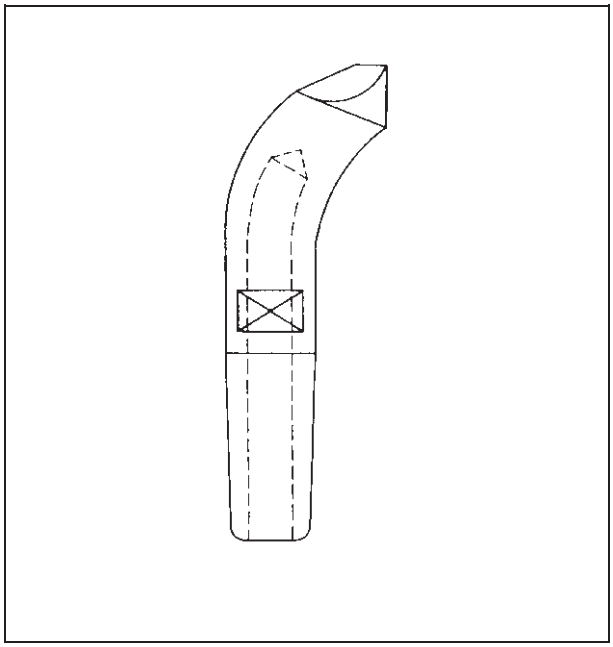


Figure 25 **Cranked offset electrode**



No.	Term	Definition
22 083	**pad electrode** flat electrode	electrode having an area of contact with the work that is much larger than the weld required
22 084	**tread**	peripheral surface of an electrode wheel
22 085	**electrode pick-up**	contamination of the resistance welding electrode by metal or scale from the surface of the workpiece
22 086	**surface pick-up**	contamination of the surface of a resistance weld by particles of the electrode
22 087	**welding die** die	device for locating the components of a workpiece in a resistance welding machine and for transmitting force and welding current to them
22 088	**insert**	small piece of metal, usually hard wearing and 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
22 089	**platen**	part of a resistance welding machine on which welding dies or bolsters can be mounted and which conveys force and welding current to them
22 090	**bolster**	electrode holder for mounting on a platen
22 091	**arm**	member projecting from a resistance welding machine, which carries current, or supports a conductor carrying current, to an electrode holder and which is required to transmit or support the welding force
22 092	**fin**	extrusion of metal extending outward beyond the upset metal in the form of a fin
22 093	**splash**	thin streaks of metal left adhering between the components or on their surfaces as the result of molten metal being expelled from a joint or from under the electrodes during spot, seam, or projection welding

No.	Term	Definition
22 094	**weld contact area** interface: *deprecated*	area through which welding current passes from one component to another during resistance welding
22 095	**electrode contact area** clamp contact area die contact area	area through which current passes from an electrode or a clamp to the workpiece
22 096	**backward force**[4] back pressure: *deprecated*	force tending to separate the electrodes
22 097	**electrode force**[4]	force transmitted by the electrodes to the workpiece
22 098	**backward pressure** back pressure: *deprecated*	pressure (force per unit area) resulting from the backward force
22 099	**hand-operated welding machine**	welding machine in which the mechanical force is applied by hand
22 100	**foot-operated welding machine** pedal-operated welding machine	welding machine in which the mechanical force is applied by means of a pedal
22 101	**power-operated welding machine**	welding machine in which mechanical force is applied by an inanimate source of power
22 102	**motor-operated welding machine**	welding machine in which the travel of the electrode is provided and the mechanical force is applied by means of a motor-driven mechanism
22 103	**portable spot-welding machine**	spot-welding machine: a) that can be carried about complete, or b) in which the electrodes, the moving arms and the force application device have flexible connections to a fixed transformer and control equipment, thus providing a limited amount of portability
22 104	**plier spot-welding machine** pincer spot-welding machine	portable spot-welding machine in which force is applied to electrodes by means of a lever system similar to that of pliers
22 105	**capacitor spot-welding machine**[5] condenser-discharge spot-welding machine	spot-welding machine in which welding current is caused to flow through the secondary winding of a transformer and the welding electrodes by the discharging of a capacitor through the primary winding of the transformer
22 106	**inductor spot-welding machine**[5] induction spot-welding machine	spot-welding machine in which the welding current is caused to flow through the secondary winding of the transformer and the welding electrodes by the interruption of the flow of a direct current through the primary winding of the transformer
22 107	**battery spot-welding machine**[5]	spot-welding machine in which a battery is used to provide the welding current
22 108	**weld slug**	piece of metal pulled from one sheet when a spot or projection weld is prised apart *NOTE The diameter of the slug may be used for weld quality assessment.*

[4] Force is sometimes incorrectly referred to as pressure. See terms 22 020 and 22 098.
[5] These machines are sometimes referred to as ''stored-energy machines''.

No.	Term	Definition
22 109	**preheat time**	duration of preheating current *NOTE In flash welding it is the time between the first passage of current and the start of continuous flashing.*
22 110	**squeeze time**[6)]	period of time between the normal application of force by the electrodes to the work and the first passage of current
22 111	**heat time**[6)] on-time	duration of each successive current impulse, in pulsation and seam welding
22 112	**step time**[6)]	*In roller spot welding and in step-by-step roller spot welding*, period of time between successive weld times
22 113	**chill time**[6)] quench time	period of time between the end of welding current and the start of post-heating current
22 114	**post-heat time**[6)]	duration of flow of post-heating current
22 115	**current-off time**[6)]	period of time between the cessation of current in one welding cycle and the beginning of current in the next
22 116	**pressure-off time**[6)]	*In spot, seam and projection welding*, period of time between two successive welding cycles when no electrode force is being applied to the workpiece
22 117	**preheating current**	current used to raise the temperature of a workpiece from ambient temperature to a predetermined value below welding temperature just before the application of welding or flashing current

[6)] Attention is drawn to Figures 26 to 37 for diagrammatic representations of these terms.

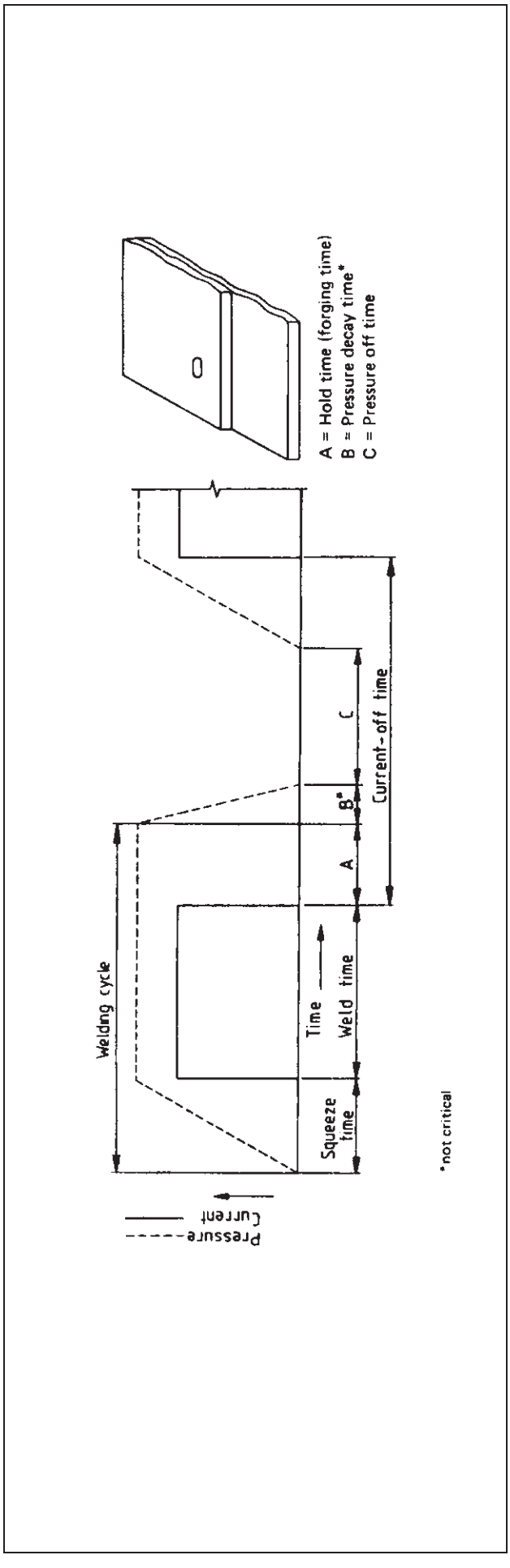


Figure 26 Time and pressure diagram for simple spot, stitch, or projection welding

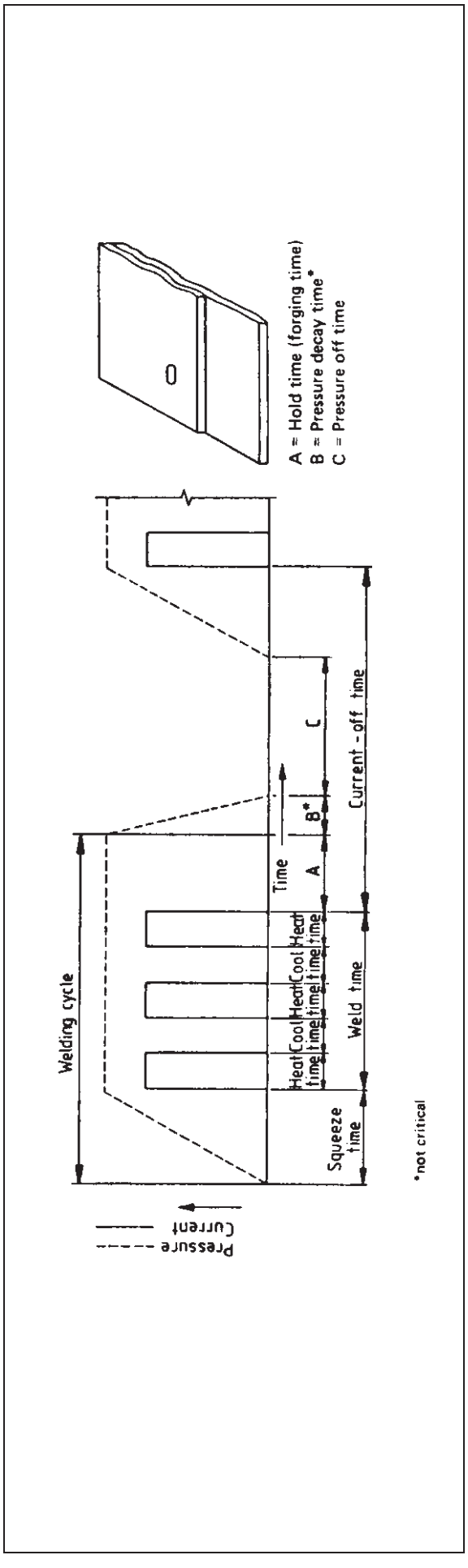


Figure 27 Time and pressure diagram for pulsation spot or projection welding

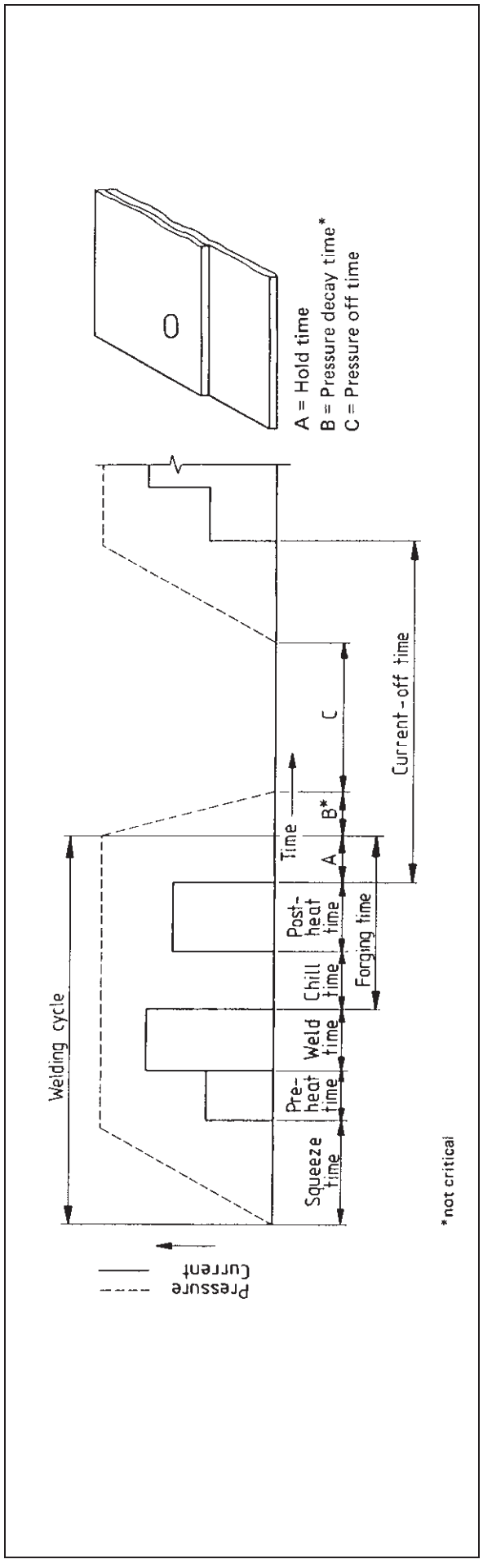


Figure 28 **Time and pressure diagram for spot or projection welding, programme control**

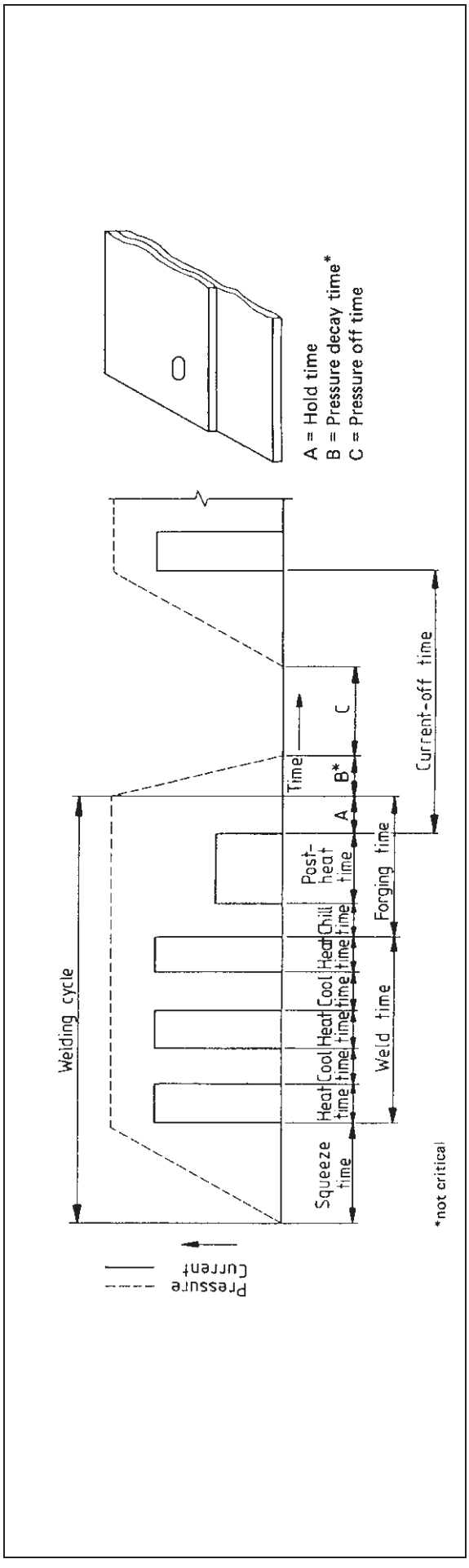


Figure 29 **Time and pressure diagram for pulsation spot or projection welding, programme control**

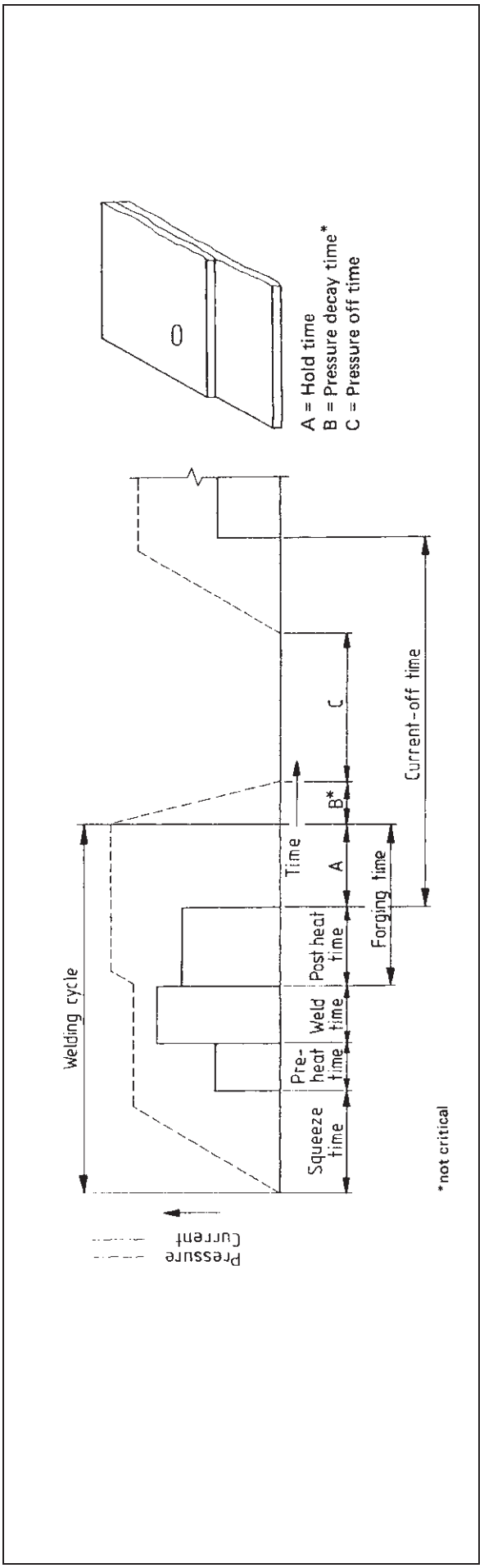


Figure 30 **Time and pressure diagram for spot welding, programme control with dual-pressure cycle**

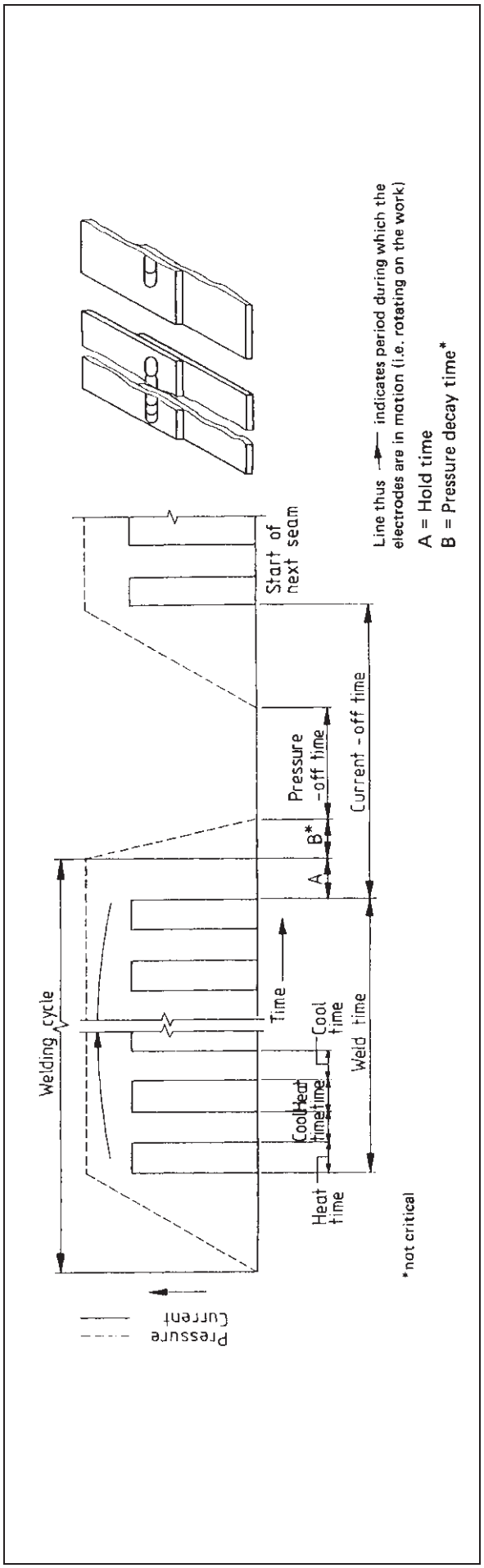


Figure 31 **Time and pressure diagram for seam welding**

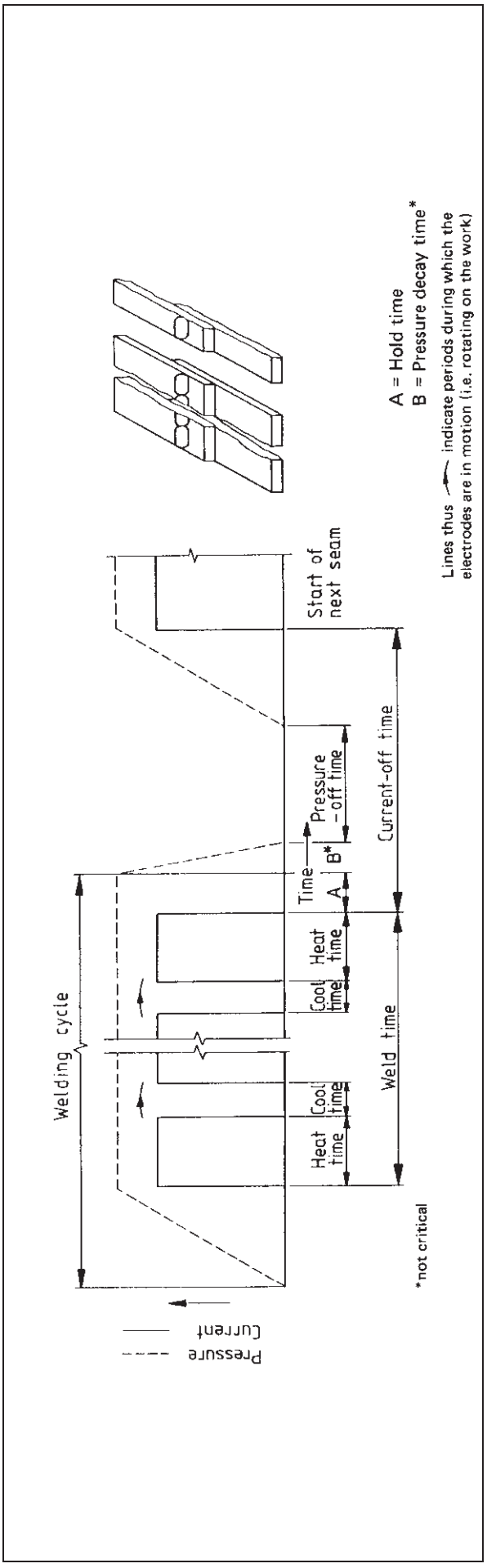


Figure 32 **Time and pressure diagram for step-by-step seam welding**

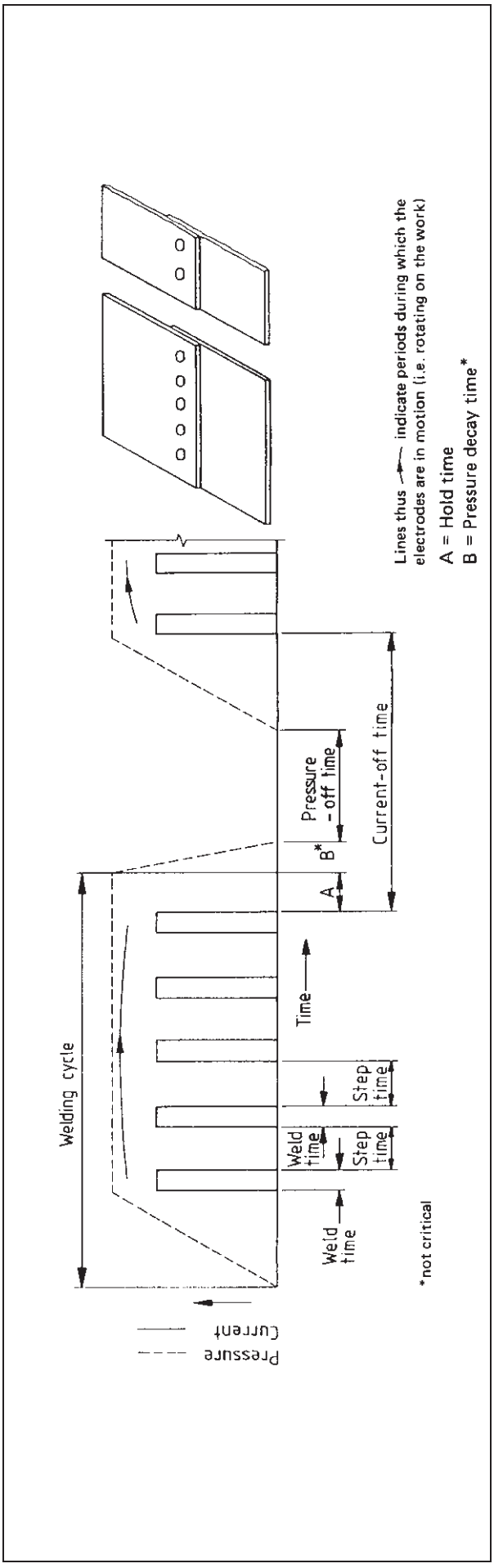


Figure 33 **Time and pressure diagram for roller spot welding**

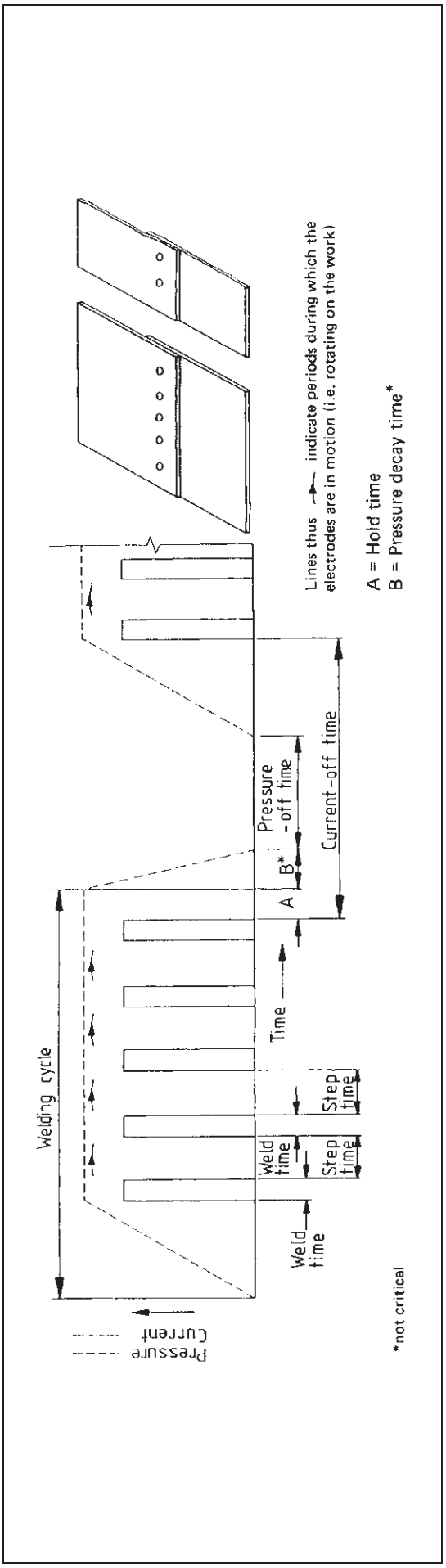


Figure 34 **Time and pressure diagram for step-by-step roller spot welding**

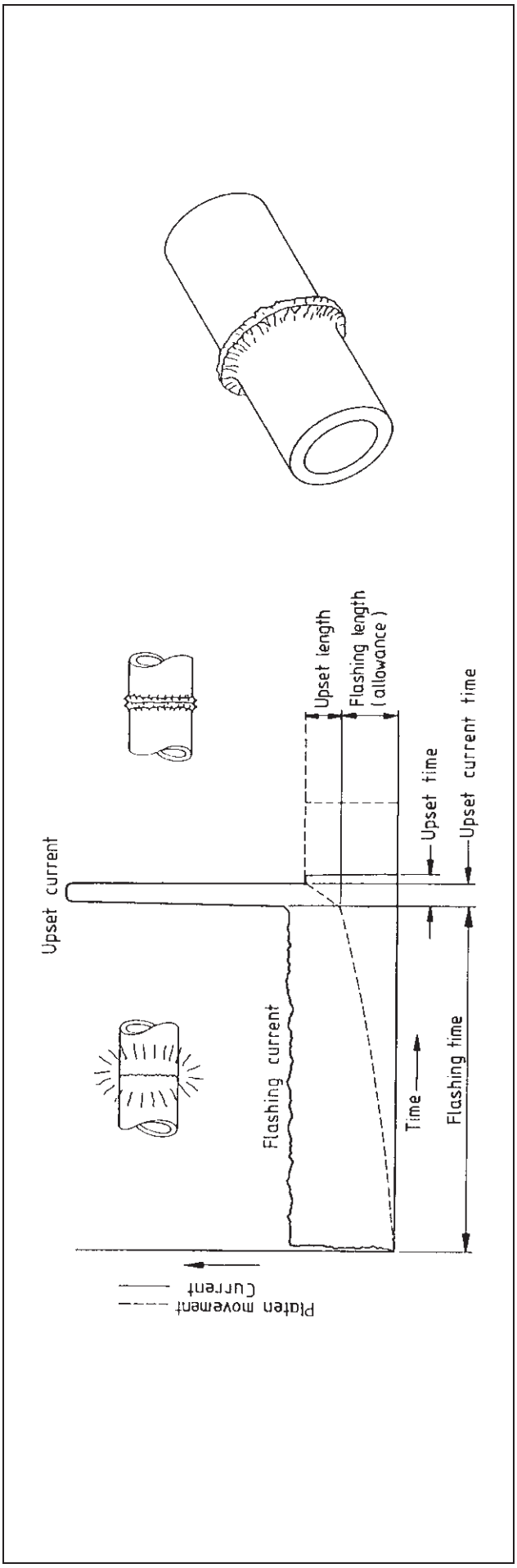


Figure 35 **Time and platen movement diagram for straight flash welding**

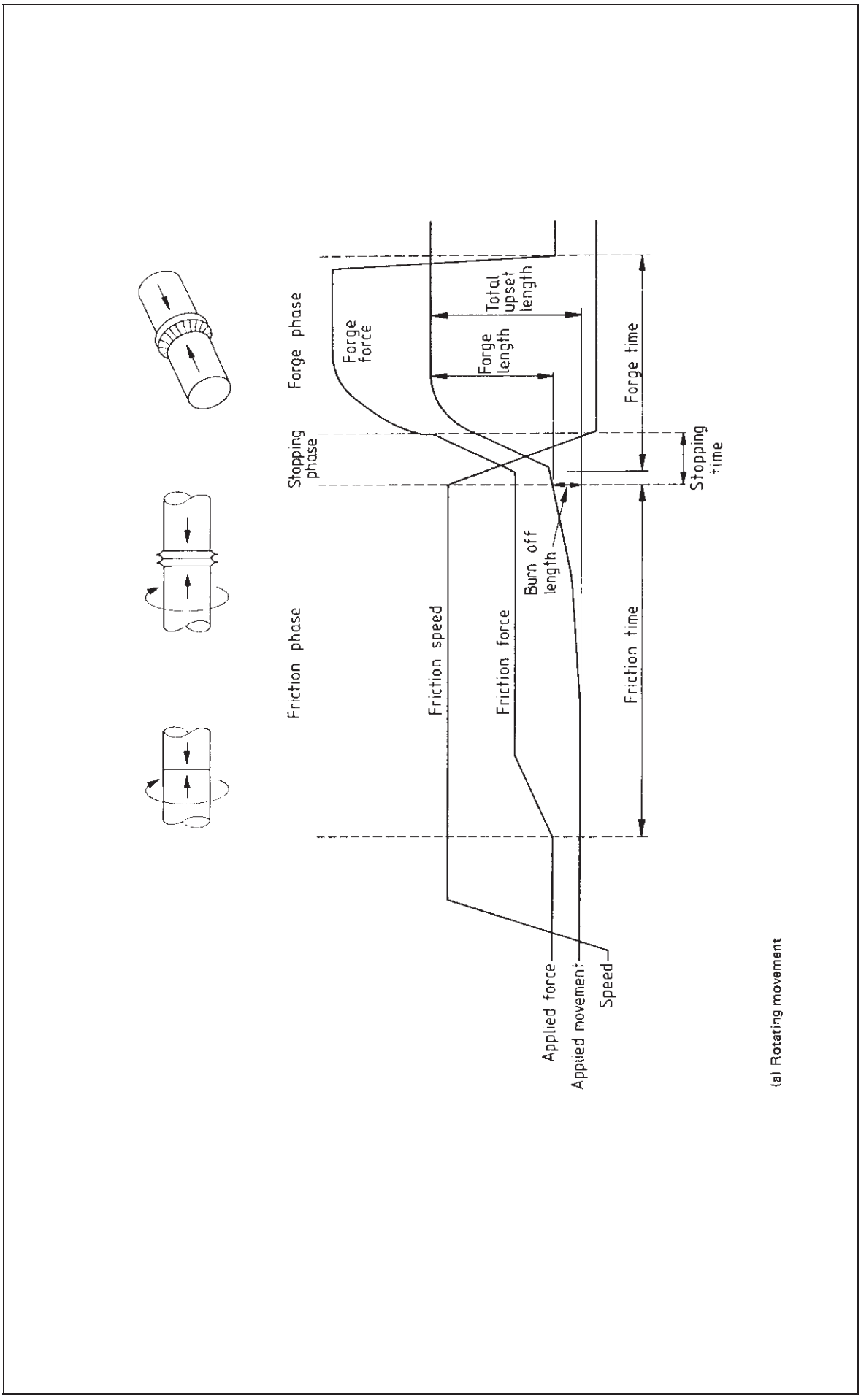


Figure 36 **Generalized diagram of speed, applied force, axial movement and time for continuous drive friction welding**

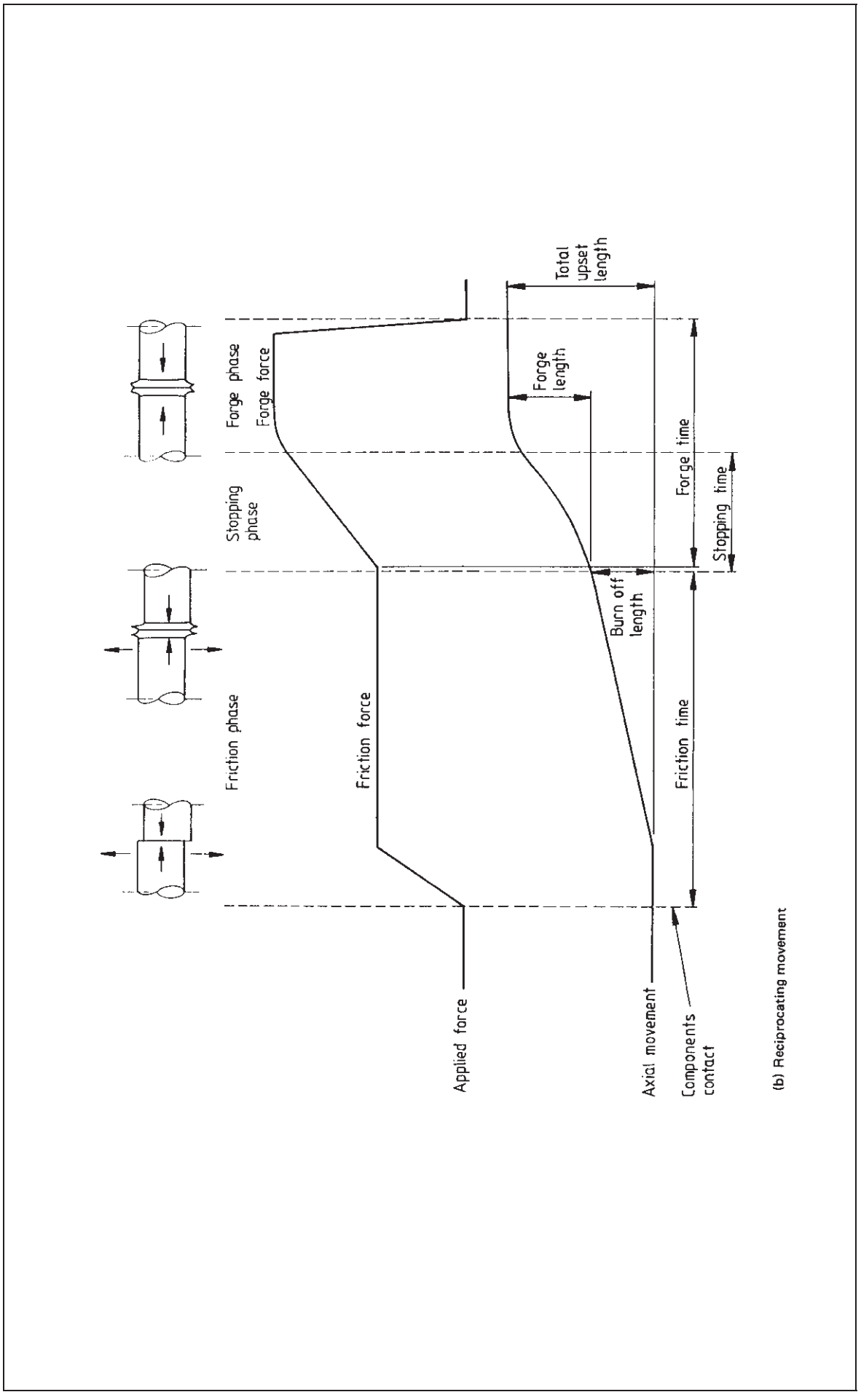


Figure 36 **Generalized diagram of speed, applied force, axial movement and time for continuous drive friction welding** *(concluded)*

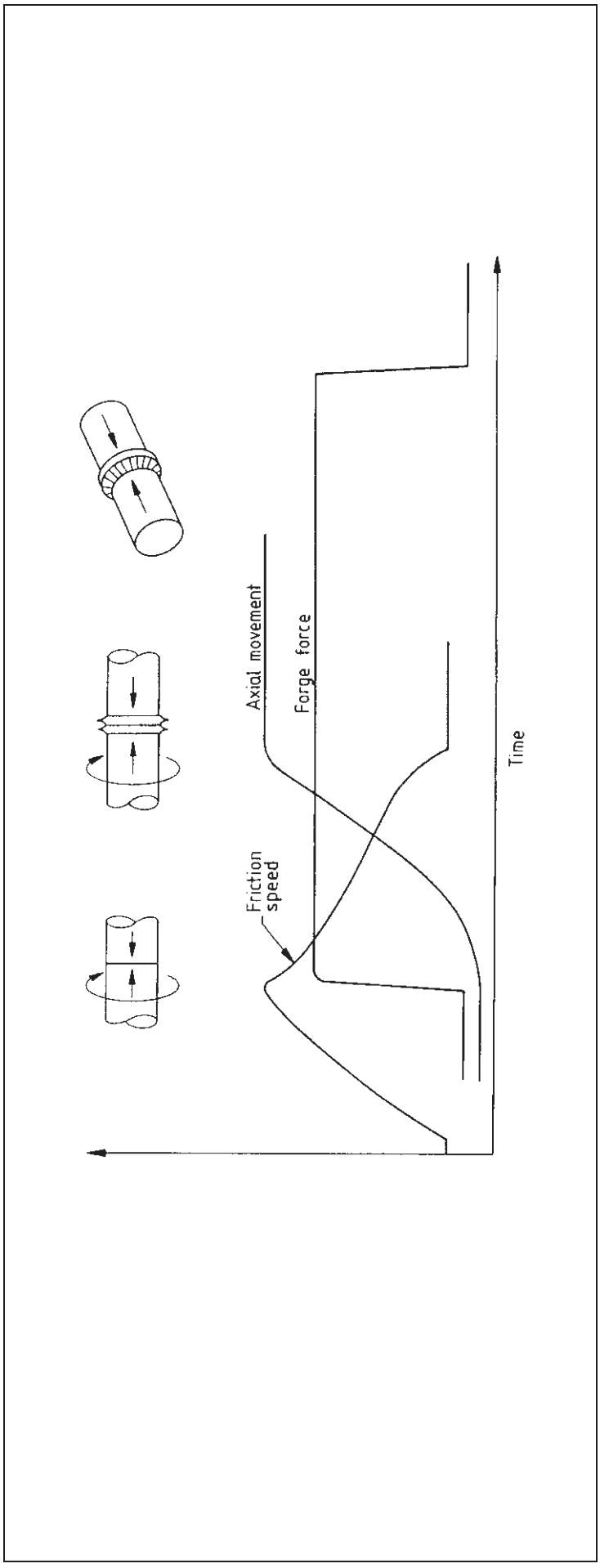


Figure 37 **Generalized diagram of speed, applied force and axial movement with time for stored energy friction welding**

No.	Term	Definition
22 118	**post-heating current**	current that is passed through a completed weld to heat it, usually for metallurgical reasons
22 119	**dual-pressure cycle**	welding cycle characterized by the application of two different predetermined electrode forces
22 120	**programme control**	method of controlling a predetermined sequence of changes of current and/or force during a welding cycle
22 121	**heat control**	means of smoothly controlling the value of the current flowing through a resistance welding machine
22 122	**constant current control**	electronic control of the value of welding current, to make its preset value constant and independent of variations in either mains voltage or the amount of magnetic material introduced into the throat of the welding machine
22 123	**synchronous control**	electronic control system that ensures that the instant of closing the circuit to a resistance welding transformer is always at a preset electrical angle to the instant of zero voltage of the a.c. supply
22 124	**non-synchronous control**	control system that does not ensure that the instant of closing the circuit to a resistance welding transformer is repetitively at the same instantaneous voltage of the a.c. supply
22 125	**phase shift**	alteration of the phase relationship between two a.c. voltages *NOTE Generally this is used to control the period of conduction in each half cycle of ignitron or thyristor contactors.*
22 126	**phase angle** firing angle	electrical angle between the instantaneous zero voltage applied to the anode of an ignitron or thyristor and the point at which it conducts in each half cycle
22 127	**slope control**	control of the rate of rise or decay of current and the time during which either takes place in the power circuit of a resistance welding machine *NOTE This should not be confused with term 32 129.*
22 128	**rate of slope**	rate of change of current when using slope control
22 129	**slope time**	duration of slope-up or slope-down
22 130	**upset travel**	1) *In resistance butt welding*. distance travelled by the moving platen in forging a weld from the point where the components are first brought together to the position where the weld is completed 2) *In flash welding*. distance travelled by the moving platen in forging a weld from the point where the components have been brought together at the end of flashing to the position where the weld is completed
22 131	**preheating loss**	total loss of length of both components during preheating a flash weld
22 132	**machine stroke**	maximum operational stroke obtainable
22 133	**operational stroke**	distance through which the electrode(s) may travel from rest to the final position during welding
22 134	**die opening** die gap	*In a flash or resistance butt welding machine*, distance between the opposing faces of the two pairs of dies when the machine is set up for welding
22 135	**clamp opening**	distance between the jaws of a clamp in the open position, through which the workpiece would be inserted or withdrawn

No.	Term	Definition
22 136	**wearing depth**	length or thickness of material that may be worn or dressed off the working surface of an electrode or die before it becomes unserviceable
22 137	**parallel spot welding**	spot welding in which the secondary current of the welding transformer is fed to two or more pairs of welding electrodes connected in parallel
22 138	**push-pull series spot welding**	series spot welding using two pairs of electrodes and two transformers so that a transformer is connected to the top and bottom electrodes respectively thereby putting all in electrical series
22 139	**unipolarity operation** unipolarity welding	resistance welding in which succeeding welds are made with pulses of the same polarity
22 140	**alternate polarity operation** alternate polarity welding	resistance welding in which succeeding welds are made with pulses of opposite polarity
22 141	**pre-weld time**	period of time between the end of squeeze time and the beginning of welding current flow
22 142	**post-weld time**	period of time between the end of welding current flow and the start of hold time
22 143	**weld delay time**	time by which the beginning of welding current flow is delayed with respect to the initiation of the forge delay timer in order to synchronize the welding force with the welding current flow
22 144	**weld heat time**	*In welding with slope control*, period of time between the beginning of slope-up and the cessation of steady current or the start of slope-down
22 145	**weld interval heat time**	weld heat time as applied to pulsation welding
22 146	**decay time**	time during which decaying of a current takes place
22 147	**decay current**	current, applied to the primary of a three-phase frequency conversion welding machine transformer at a level below the welding current, that determines the decay time and rate of decay
22 148	**current decay**	current that decreases from an initial preset value to a final preset value at a rate depending upon the time constant of the circuit
22 149	**electronic frequency converter**	electronic device that converts the welding power from the frequency of the power supply to a different value
22 150	**two-stage initiation**	method of operation in which closure of the first stage of the initiation switch initiates the electrode force and closure of the second stage initiates the remainder of the welding cycle *NOTE The closure of the second stage may, or may not, immediately follow the closure of the first stage. The first stage is non-beat after closing the second stage. The second stage is not capable of being initiated if the first stage is open.*
22 151	**repeat operation**	method of operation in which once the weld cycle has been initiated it is repeated until the initiation switch is opened
22 152	**non-repeat operation** single operation	method of operation in which each initiation of the initiation switch provides one welding cycle only
22 153	**non-beat**	type of system that prevents any interruption of the welding cycle once the initiation switch has been operated

No.	Term	Definition
22 154	**delayed non-beat**	type of system which permits the interruption of the welding cycle only up to the end of squeeze time
22 155	**gun welding head** gun	force-producing and electrode-carrying assembly of a gun welding machine
22 156	**dual gun control**	method of control in which the welding cycle from one controller can be switched to either of two gun welding heads supplied from one transformer
22 157	**dual gun dual welding cycle control** dual gun dual sequence control	method of control in which the welding cycle to each of the gun welding heads supplied from one transformer can be controlled independently, the initiation circuit being interlocked to allow the operation of only one gun at a time
22 158	**delayed firing**	delayed initiation of the welding current in the first half cycle in order to minimize the initial transient of magnetizing current of the welding transformer
22 159	**cascade firing** sequence firing: *deprecated*	*In multi-weld applications*, system of switching in which each transformer or group of transformers is switched in succession, with or without current-off time during switching *NOTE This system may be used to limit the supply load.*
22 160	**electrode face**	surface of an electrode that makes contact with the workpiece
22 161	**back plate**	plate to which two or more bolsters can be bolted to hold them in their correct relative positions
22 162	**back-up die**	die into which may be inserted a number of removable inserts or electrodes
22 163	**angle centre electrode**	angle electrode in which the electrode tip is concentric with the electrode shank (see Figure 38)
22 164	**swan-necked electrode** double-cranked electrode	cranked offset electrode with a second bend (see Figure 39)
22 165	**averaging time**	time that is the sum of the maximum allowable conducting (on) time at maximum current and the minimum safe off time in a duty cycle for equipment which may be damaged by any thermal overload

Figure 38 **Angle centre electrode**

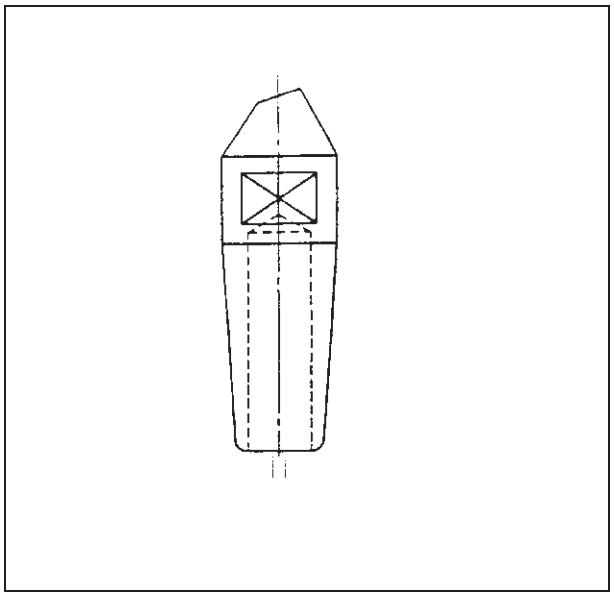
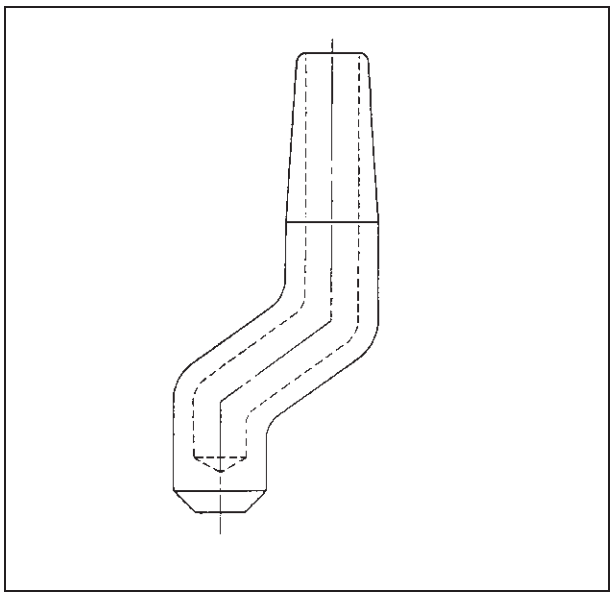


Figure 39 **Swan-necked electrode**



No.	Term	Definition
22 166	**welding pressure time**	period during which the welding force is maintained in the making of a weld
22 167	**post-heating pressure time**	duration of electrode pressure associated with any post-heat treating cycle
22 168	**head lowering time**	period from the instant the electrode leaves the ''at rest'' position between successive welds to the instant of touching the workpiece
22 169	**pressure application time**	total time in any one welding cycle of the application of force by the electrodes to the workpiece
22 170	**pressure decrease time**	time taken for the force applied by the electrodes to the work to change from one steady value to a lower steady value or to zero
22 171	**touch time**	one period when two parts to be welded are in contact during reciprocating preheating for flash welding
22 172	**heat diffusion time**	one period when two parts to be welded are separated and no current is flowing between them during reciprocating preheating for flash welding
22 173	**initial current**	steady value of current applied before the commencement of slope-up in welding with slope control
22 174	**final current**	final steady value of current at the end of the slope-down period of a welding cycle
22 175	**phase displacement**	alteration of the phase relationship of two alternating electrical functions so that they do not pass through zero at the same time
22 176	**cycle counter**	electronic or electromechanical device for counting the number of cycles during a period of flow of an alternating current
22 177	**cycle recorder**	electronic or electromechanical device for recording, on paper or film, the number of cycles during a period of flow of an alternating current
22 178	**modulator**	electromechanical device to control the value of current during the heat and cool times in seam welding
22 179	**multi-pressure cycle**	welding in which more than one steady value of electrode force is used during any one welding cycle
22 180	**high lift system**	arrangement whereby the maximum electrode clearance for insertion and withdrawal of the workpiece is much greater than the operational stroke
22 181	**electrode gap** electrode clearance	distance between two corresponding electrode faces when the machine is ready for operation
22 182	**follow-up**	movement of an electrode assembly that keeps the electrode force applied while surface indentation or collapse is occurring on the workpiece
22 183	**preheating allowance**	*In flash welding*, length allowed for the total shortening of both components due to a preheating operation
22 184	**push gun** poke gun	gun welding head with which the welder applies the welding force by direct manual pushing

No.	Term	Definition
22 185	**expansion gun** reaction gun	gun welding head that can be used between a workpiece and a fixed member and which derives the welding force by longitudinal expansion
22 186	**rocker arm**	moveable arm of a welding machine which is pivoted approximately centrally and is pushed upward at one end to bring down the end that carries the moving electrode into contact with the fixed electrode
22 187	**rotary welding transformer**	transformer for a butt-seam welding machine that is connected solidly to the wheel electrodes and rotates with them, while the primary current at mains voltage is led in through slip rings
22 188	**welding pressure head** pressure head	assembly of those parts of a welding machine that produce the force required for welding
22 189	**electrode wheel head**	part of a seam welding machine that carries the electrode wheel that is lowered and raised to and from the workpiece
22 190	**weld-through sealer**	mastic gap-filling material that is applied prior to resistance welding to an unpainted metal surface for non-pressure sealing purposes and does not prevent the making of a satisfactory weld

Subsection 23. Terms relating only to friction welding

No.	Term	Definition
23 001	**friction welding**	welding with pressure in which the interfaces are heated by friction by relative movement of the joint faces, normally by rotating one or both workpieces in contact with each other or by means of a separate rotating friction element; the weld is completed by an upset force, generally after rotation has ceased (see Figure 36 and Figure 37)
23 002	**friction force**	force(s) applied normal to the faying surfaces during the time that there is relative movement between the components
23 003	**friction pressure**	pressure (force per unit area) on the faying surfaces resulting from the friction force
23 004	**friction speed**	rate of relative movement of the components
23 005	**friction time**	time during which relative movement between the components takes place at friction speed and under application of the friction force
23 006	**forging speed**	*in friction welding*, relative velocity of the workpieces at the instant the forge force is applied
23 007	**burn-off length**	overall length loss of the components during the application of the friction force
23 008	**flash**	metal extruded during friction welding
23 009	**friction stir welding**	friction welding where heat is generated by friction between a rotating non-consumable spindle and stationary workpieces (see Subsection **27**)
23 010	**friction welding forge force**	longitudinal force applied to the faying surfaces at the time when relative movement between the components is ceasing or has ceased

No.	Term	Definition
23 011	**forging pressure** forge pressure	pressure (force per unit area) resulting from the forging force
23 012	**forge length**	amount by which the overall length of the components is reduced during the application of the forge force
23 013	**forge rate**	rate of shortening of the components during the application of the forge force
23 014	**stopping time**	time required by the moving component to decelerate from friction speed to zero speed

Subsection 24. Terms relating only to pressure welding

No.	Term	Definition
24 001	**pressure welding** solid-phase welding	welding process in which a weld is made by a sufficient pressure to cause plastic flow of the surfaces, which may or may not be heated
24 002	**HF pressure welding**	pressure welding in which heat derived from a high frequency alternating electric current of at least 10 kHz, induced or conducted into the workpiece, is used to make plastic the surfaces to be united
24 003	**oxy-acetylene pressure welding**	pressure welding in which an oxy-acetylene flame is used to make plastic the surfaces to be united *NOTE Other fuel gases are sometimes used and in such cases appropriate alterations to the term and the definition are necessary.*
24 004	**constant-pressure pressure welding**	pressure welding in which the weld is made during the period of increasing temperature at a substantially constant pressure
24 005	**constant-temperature pressure welding**	pressure welding in which the weld is made during the application of increasing pressure at a substantially constant temperature
24 006	**cold pressure welding**	pressure welding in which pressure alone is used
24 007	**heating time**	in constant-temperature pressure welding, time during which the parts are heated before the application of the upsetting force
24 008	**upsetting time**	*In constant-temperature pressure welding*, time during which the parts to be joined are maintained at the welding temperature and under the upsetting force
24 009	**welding time**	sum of the heating time and the upsetting time
24 010	**deformation**	local percentage reduction in the total thickness of sheets or plates at a pressure-welded lap joint

Subsection 25. Terms relating only to diffusion welding

No.	Term	Definition
25 001	**diffusion welding**	joining process wherein all the faces to be welded are held together by a pressure insufficient to cause readily detectable plastic flow, at a temperature below the melting point of any of the parts, the resulting solid state diffusion, with or without the formation of a liquid phase, causing welding to occur

No.	Term	Definition
25 002	**solid state diffusion welding**	diffusion welding in which all the reactions occur in the solid state
25 003	**liquid phase diffusion welding**	diffusion welding in which solid state interdiffusion between dissimilar materials results in the formation of a liquid phase

Subsection 26. Terms relating only to explosive welding

No.	Term	Definition
26 001	**explosive welding**	pressure welding process to make lap joints or cladding in which the overlapping workpieces are welded when impacted together by the detonation of an explosive charge
26 002	**parent plate; static plate**	stationary plate in a lap joint or plate to be clad
26 003	**flyer plate**	moving plate in a lap joint or the cladding to be applied to the parent plate
26 004	**anvil**	support on which the parent plate rests
26 005	**buffer**	solid material placed between the explosive and the flyer plate to transmit the explosive force and to protect the flyer plate
26 006	**initial plate angle** initial inclination	angle of inclination between the flyer plate and the parent plate before welding
26 007	**collision angle** contact angle	angle of inclination between the flyer plate and the parent plate during welding
26 008	**stand-off distance** stand-off gap	distance between the plates in a parallel assembly
26 009	**collision front**	three-dimensional line of collision points or lines of contact
26 010	**jet**	air, expelled from between the plates during the explosion, which cleanses the two surfaces to be joined
26 011	**shocked metal zone**	parts of the plates that are metallurgically affected by the impact
26 012	**blending taper**	conically prepared end of a tube usually for tube to tube-plate welding
26 013	**distortion plug** distortion bung	plugs inserted into vacant holes of a tube-plate to prevent the distortion of the ligament by welds carried out in the adjacent holes

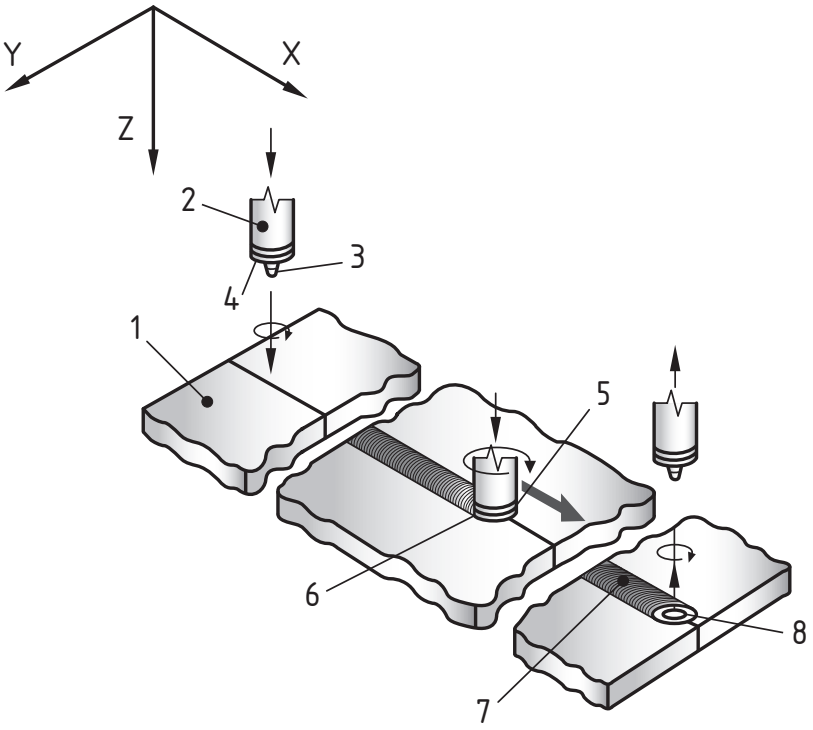
Subsection 27. Terms relating only to friction stir welding

No.	Term	Definition
27 001	**tool**	rotating component that includes the shoulder and probe (see Figure 40)
27 002	**probe**	part of the tool that extends into the workpiece to make the weld (see Figure 40 and Figure 41) *NOTE The probe can be either fixed or adjustable.*
27 003	**z-direction**	direction parallel to the tool axis (see Figure 40)

27 004 **x-direction** direction parallel to the direction of travel in the plane of the workpiece (see Figure 40)

27 005 **y-direction** direction normal to the direction of travel in the plane of the workpiece (see Figure 40)

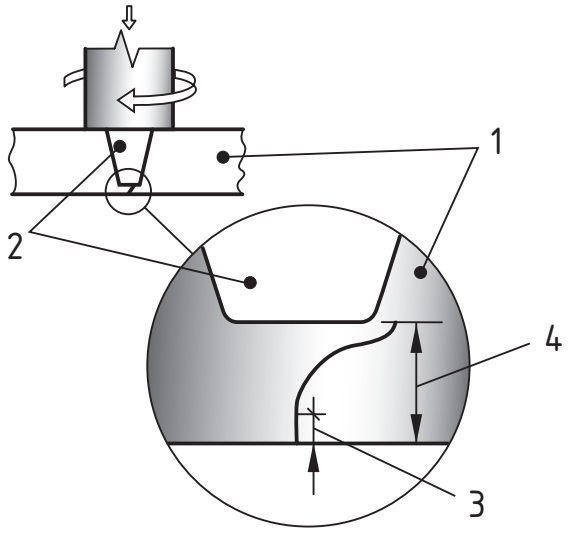
Figure 40 **Basic principle of friction stir welding**



Key

1 Workpiece
2 Tool
3 Probe
4 Shoulder
5 Advancing side of weld
6 Retreating side of weld
7 Weld surface
8 Exit hole

Figure 41 **Macrosection of a butt weld showing incomplete penetration**

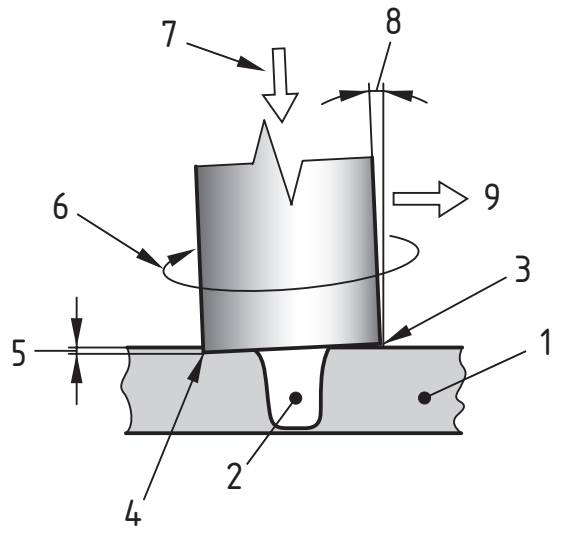


Key

1 Workpiece
2 Probe
3 Original joint line – no deformation
4 Original joint line – severely plastically deformed

No.	Term	Definition
27 006	**fixed probe**	probe that has a fixed length protruding from the shoulder and its rotation is the same as the shoulder during welding
27 007	**shoulder**	surface of the tool that contacts the workpiece during welding (see Figure 40 and Figure 42)
27 008	**adjustable probe tool**	probe that has adjustable length and its rotation may be different from the shoulder during welding (see Figure 43) *NOTE 1 An adjustable probe may be used as a fixed probe.* *NOTE 2 This tool enables joining to be accomplished without creating excessive toe flash at the start, or an exit hole at the finish.*
27 009	**heel**	part of the tool shoulder that is at the rear of the tool relative to its forward motion (see Figure 42)

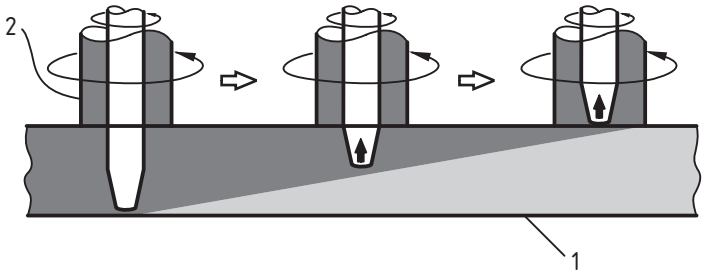
Figure 42 **Heel and heel plunge depth**



Key

1 Workpiece
2 Probe
3 Shoulder
4 Heel
5 Heel plunge depth
6 Rotary motion
7 Down force
8 Tilt angle
9 Direction of travel

Figure 43 **Adjustable probe tool**

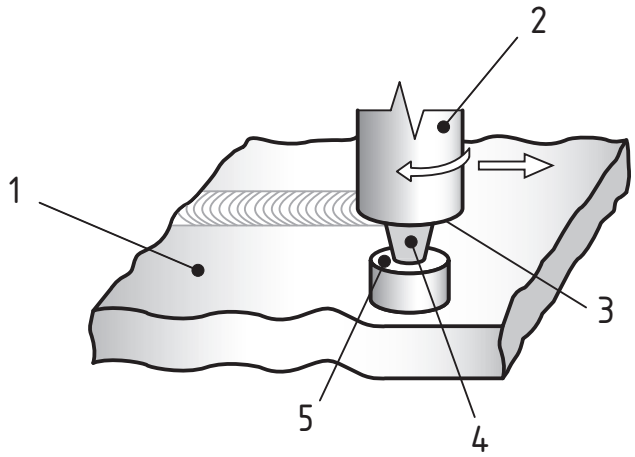


Key

1 Workpiece
2 Adjustable probe tool

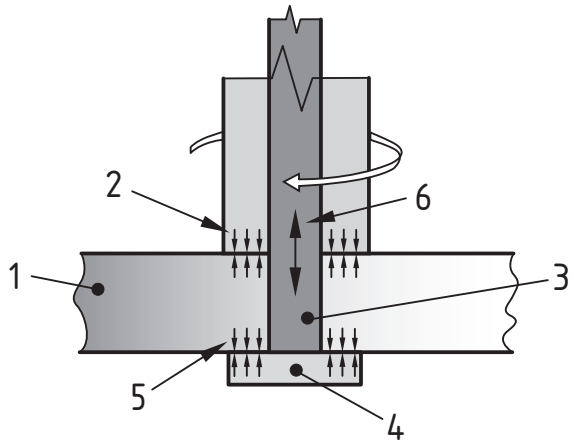
No.	Term	Definition
27 010	**fixed bobbin tool**	tool with two shoulders separated by a fixed length probe (see Figure 44)
27 011	**self-reacting bobbin tool**	tool with two shoulders separated by a probe whose length can be adjusted during welding (see Figure 45) *NOTE The self-reacting bobbin tool allows the shoulders to automatically maintain contact with the workpiece.*

Figure 44 **Fixed bobbin tool**



Key
1 Workpiece
2 Bobbin tool
3 Upper shoulder
4 Probe
5 Lower shoulder

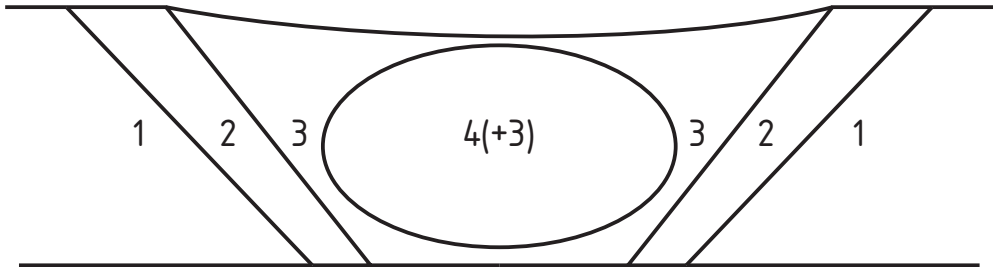
Figure 45 **Self-reacting bobbin tool**



Key
1 Workpiece
2 Top shoulder
3 Probe
4 Bottom shoulder
5 Reactive forces

No.	Term	Definition
27 012	**position control**	method to provide the required position of the tool during welding
27 013	**lateral offset**	distance from the tool axis to the root face
27 014	**tilt angle** travel angle	angle between the normal to the plane of the workpiece surface and the tool axis measured in the Z-X plane of travel of the tool axis (see Figure 42)
27 015	**sideways tilt angle** work angle	angle between the normal to the plane of the workpiece surface and the tool axis measured in the Z-Y plane normal to the direction of travel of the tool
27 016	**tool plunge depth**	inserting the tool into the workpiece in order to make a weld
27 017	**heel plunge depth**	distance the heel extends into the parent material (see Figure 42)
27 018	**advancing side**	side of the weld where the direction of tool rotation is the same as the welding direction (see Figure 40)
27 019	**retreating side**	side of the weld where the direction of tool rotation is opposite to the welding direction (see Figure 40)
27 020	**force control**	method to provide the required force on the tool during welding
27 021	**down force** traversing force z-force	axial force applied in the z-direction by the tool to the workpiece during welding in the x-direction (see Figure 42)
27 022	**sideways force** y-force	Force experienced in the y-direction by the tool to the workpiece during welding in the x-direction
27 023	**traversing force** x-force	force applied in the x-direction by the tool to the workpiece during welding in the x-direction
27 024	**travel speed** welding speed traversing speed traversing rate	*In friction stir welding*, distance travelled by the probe axis, in a direction parallel to the joint axis, per unit time *NOTE No account is taken of any lateral oscillation of the probe axis.*
27 025	**dwell time at start of weld**	time interval between when the rotating tool reaches its maximum depth in the parent material and the start of travel
27 026	**dwell time at end of weld**	time interval after travel has stopped but before the rotating tool has begun to withdraw from the weld
27 027	**heat affected zone** **HAZ**	area affected only by heat with no visible macroplastic deformation detectable by using optical microscopy (see Figure 46)
27 028	**thermomechanically affected zone** **TMAZ**	area affected by both heat and macroplastic deformation (see Figure 46)
27 029	**nugget**	part of the TMAZ where the microstructure has been subject to recrystalization (see Figure 46) *NOTE In most aluminium alloys, the nugget is bounded by unrecrystalized TMAZ. In many other alloys, the nugget extends most or all of the TMAZ, and possibly into the HAZ.*

Figure 46 **Cross-section of a friction stir weld**

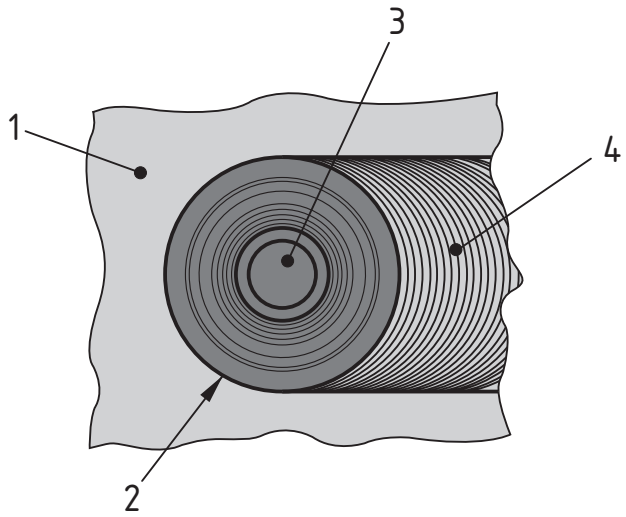


Key

1 Parent material
2 Heat affected zone (HAZ)
3 Thermomechanically affected zone (TMAZ)
4 Nugget

No.	Term	Definition
27 030	**exit hole**	hole remaining at the end of a weld after the withdrawal of the tool (see Figure 40 and Figure 47)
27 031	**shoulder footprint**	partially or fully formed ring surrounding the exit hole (see Figure 47)

Figure 47 **Tool shoulder footprint visible at the exit hole**



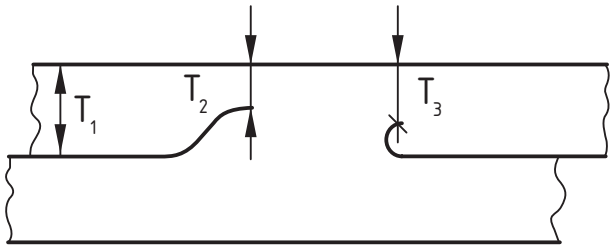
Key

1 Workpiece
2 Shoulder footprint
3 Exit hole
4 Weld surface

No.	Term	Definition
27 032	**flash**	imperfection consisting of excessive metal protruding upwards at the weld toe
27 033	**underfill**	depression resulting when the weld face is below the adjacent parent material surface
27 034	**incomplete penetration**	imperfection where the full thickness of the joint has not been welded (see Figure 41)

No.	Term	Definition
27 035	**void** volumetric flaw	non-planar discontinuity in the TMAZ which may be buried or surface breaking *NOTE The extent may be classified as continuous, sporadic, isolated or clustered, fine, coarse, etc.*
27 036	**joint line remnant**	imperfection consisting of a semi-continuous layer of oxide in the weld *NOTE The severity of this imperfection depends upon its extent and the proximity of the adjacent oxide particles. Joint line remnants can have some effect on the mechanical performance of the joint.*
27 037	**kissing bond**	weakly bonded joint line remnant in the root region, often difficult to detect non-destructively
27 038	**hook**	curved notch on the advancing side of the lap weld (see Figure 48, T_3)
27 039	**lap joint sheet thinning**	workpiece thickness minus the distance from the weld face to the end of the hook (see Figure 48) *NOTE In Figure 48, the sheet thinning in the lap joint is $T_1 - T_2$ or $T_1 - T_3$.*

Figure 48 **Cross-section of friction stir lap weld showing undesirable/extreme plate thinning on the retreating side and a hook feature on the advancing side of the weld**



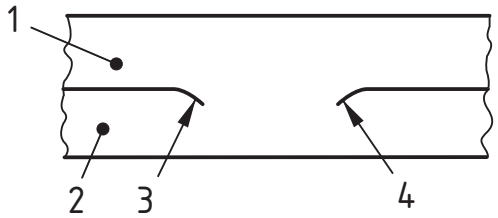
a) Upper plate thinning

Key

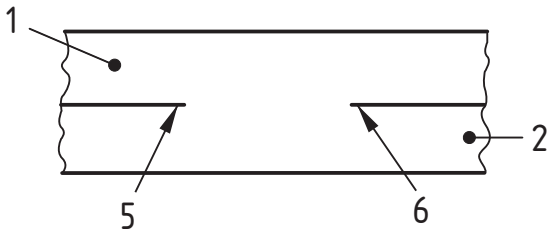
T_1 Sheet thickness

T_2 Retreating side, sheet thickness

T_3 Advancing side, sheet thickness



b) Lower plate thinning



c) Ideal situation

Key

1 Upper workpiece

2 Lower workpiece

3 Retreating side, notch tip orientation away from shoulder side

4 Advancing side, notch tip orientation away from shoulder side

5 Retreating side, notch tip abrupt end

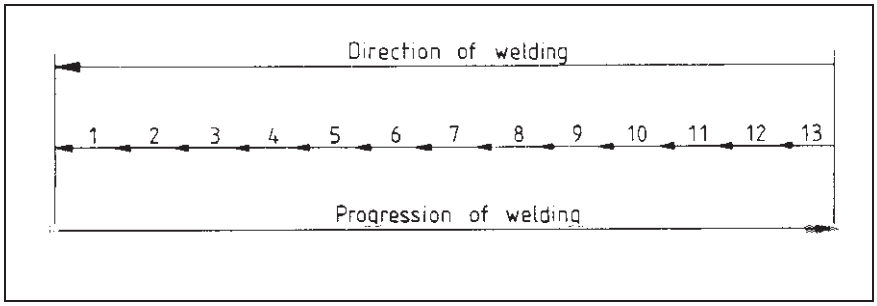
6 Advancing side, notch tip abrupt end

Section 3. Terms relating to fusion welding (welding without pressure)

Subsection 31. Terms relating to more than one subsection

No.	Term	Definition
31 001	**fusion welding**	welding without application of external force in which the faying surface(s) has (have) to be molten; usually, but not necessarily, molten filler metal is added
31 002	**back-step sequence**	welding sequence in which short lengths of run are deposited in a direction opposite to the general progress of welding the joint (see Figure 49)

Figure 49 **Example of back-step sequence**



No.	Term	Definition
31 003	**back-step welding**	welding following a back-step sequence
31 004	**continuous weld**	weld extending along the entire length of a joint
31 005	**intermittent weld**	series of welds of the same type and dimensions at intervals along a joint
31 006	**butt weld**	1) *In a butt joint*. weld between two parts making an angle to one another of 135° to 180° inclusive in the region of the weld such that a line parallel to a surface of one part, perpendicular to the line of the joint, and passing through the centre of the fusion face of that part, passes through the fusion face of the other part (see Figure 50.1 to Figure 50.11, Figure 50.13, Figure 50.15 and Figure 50.16) 2) *In a T-joint*. weld between two parts making an angle to one another of 45° to 90° inclusive in the region of the weld such that a line parallel to a surface of one part, perpendicular to the line of the joint, and passing through the centre of the fusion face of that part, passes through the fusion face of the other part (see Figure 50.19, Figure 50.21, Figure 50.23 and Figure 50.24) 3) *In a corner joint*. weld between two parts making an angle to one another of 45° to 135° inclusive in the region of the weld such that a line parallel to a surface of one part, perpendicular to the line of the joint, and passing through the centre of the fusion face of that part, passes through the fusion face of the other part (see Figure 50.32)

No.	Term	Definition
31 007	**square butt weld**	butt weld in the preparation for 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 Figure 50.1 to Figure 50.6)
31 008	**single-V butt weld**	butt weld in the preparation for which the edges of both parts are bevelled so that in cross section the fusion faces form a V (see Figure 50.7 to Figure 50.9)
31 009	**staggered intermittent weld**	intermittent weld on each side of a joint (usually fillet welds in T and lap joints) arranged so that the welds on one side lie opposite to the spaces on the other side along the joint
31 010	**double-V butt weld**	butt weld in the preparation for which the edges of both components are double bevelled so that in cross section the fusion faces form two opposing V s (see Figure 50.10, Figure 50.11 and Figure 50.13)
31 011	**single-U butt weld**	butt weld in the preparation for which the edges of both components are prepared so that in cross section the fusion faces form a U

Figure 50 **Sketches of types of joints, types of weld(s) and weld preparations**

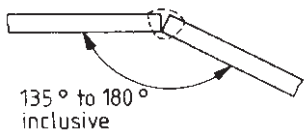
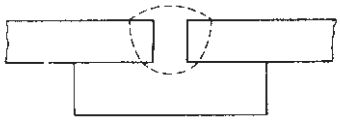
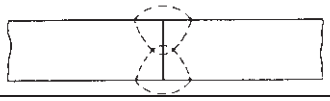
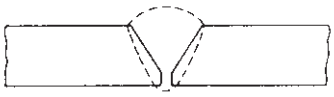
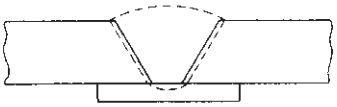
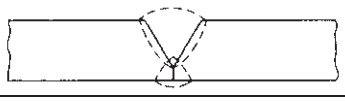
Figure no.	Sketch	Type of joint	Type of weld(s)	Preparation	Remarks
50.1		Butt	Butt	Close square	Full penetration
50.2		Butt	Butt	Close square	Full penetration
50.3		Butt	Butt	Raised edges	—
50.4		Butt	Butt	Close square	Partial penetration
50.5		Butt	Butt	Open square with backing bar	Full penetration
50.6		Butt	Butt	Close square	Full penetration. Welded from both sides
50.7		Butt	Butt	Single-V with root faces.	Full penetration
50.8		Butt	Butt	Single-V with backing strip	Full penetration
50.9		Butt	Butt	Single-V with root faces	Full penetration. Sealing run used

Figure 50 **Sketches of types of joints, types of weld(s) and weld preparations** *(continued)*

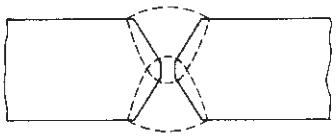
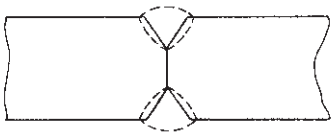
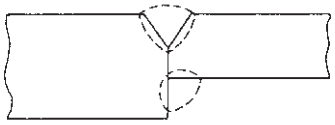
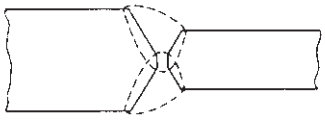
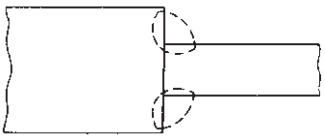
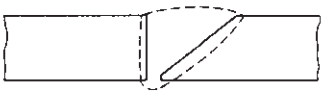
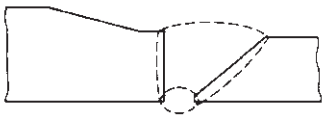
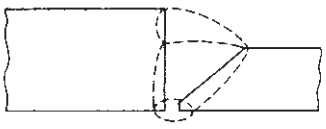
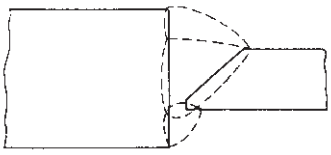
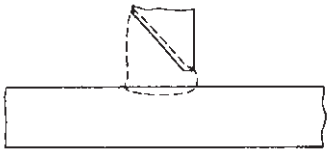
Figure no.	Sketch	Type of joint	Type of weld(s)	Preparation	Remarks
50.10		Butt	Butt	Double-V with root faces	Full penetration. Welded from both sides
50.11		Butt	Butt	Double-V with broad root faces	Partial penetration. Welded from both sides
50.12		Butt	Butt and fillet	Single-V with broad root faces	Partial penetration. Welded from both sides
50.13		Butt	Butt	Double-V with root faces	Full penetration. Welded from both sides
50.14		Butt	Fillet	Close square	Welded from both sides
50.15		Butt	Butt	Single-bevel with root face	Full penetration
50.16		Butt	Butt	Single-bevel with root face. Thicker plate tapered	Full penetration. Sealing run used
50.17		Butt	Compound of butt and fillet	Single-bevel with root face	Full penetration. Sealing run used
50.18		Butt	Compound of butt and fillet	Single-bevel with root face	Full penetration. Welded from both sides
50.19		T	Butt	Single-bevel with root face	Full penetration

Figure 50 **Sketches of types of joints, types of weld(s) and weld preparations** *(continued)*

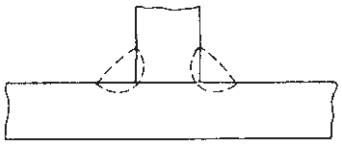
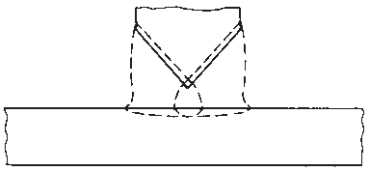
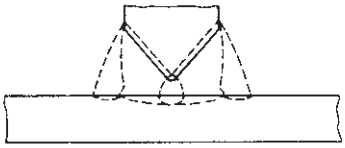
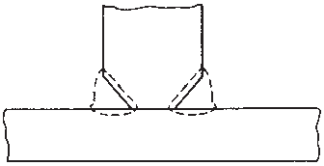
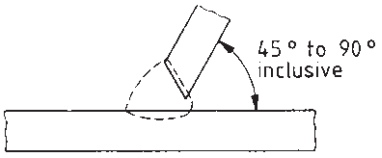
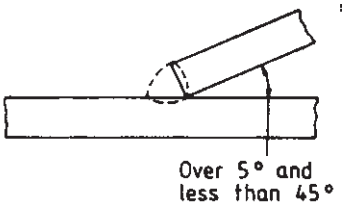
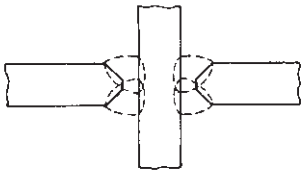
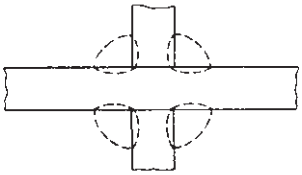
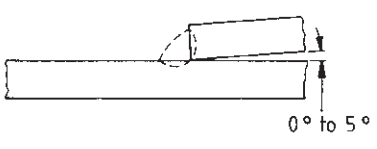
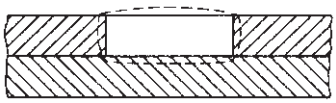
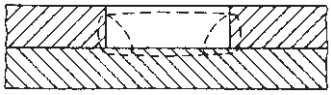
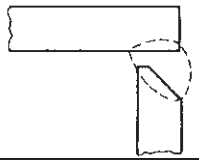
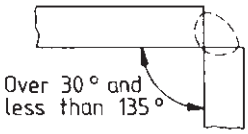
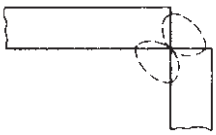
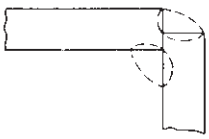
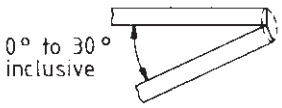
Figure no.	Sketch	Type of joint	Type of weld(s)	Preparation	Remarks
50.20		T	Fillet	Close square	Welded from both sides
50.21		T	Butt	Double-bevel	Full penetration. Welded from both sides
50.22		T	Compound of butt and fillets	Double-bevel	Full penetration. Welded from both sides
50.23		T	Butt	Double-bevel with wide or deep root face	Partial penetration. Welded from both sides
50.24		T	Butt	Single-bevel	Full penetration
50.25		T	Fillet	Edge prepared as necessary	—
50.26		Cruciform	Butt	Double-bevel	Welded from both sides
50.27		Cruciform	Fillet	Close square	Welded from both sides
50.28		Lap	Fillet	Square edge	—

Figure 50 **Sketches of types of joints, types of weld(s) and weld preparations** *(concluded)*

Figure no.	Sketch	Type of joint	Type of weld(s)	Preparation	Remarks
50.29		Lap	Plug	Holes(s) of any shape in one plate	—
50.30		Lap	Fillet	Hole(s) of any shape in one plate	Welded all round
50.31		Lap	Fusion spot	None	—
50.32		Corner	Butt	Single-bevel with root face	Full penetration
50.33		Corner	Fillet	Edge prepared as necessary	—
50.34		Corner	Fillets	Square edge	Welded from both sides
50.35		Corner	Fillets	Square edge	Partially-lapped corner. Welded from both sides
50.36		Edge	Edge	Square edge	Edges fully covered

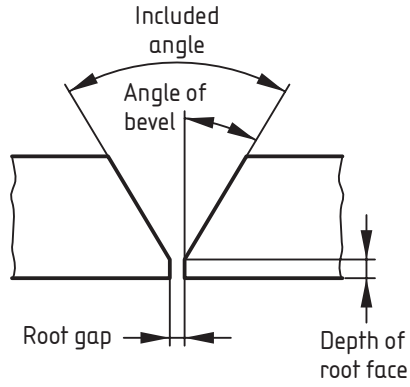
No.	Term	Definition
31 012	**double-U butt weld**	butt weld in the preparation for which the edges of both components are prepared so that in cross section the fusion faces form two opposing Us having a common base
31 013	**single-J butt weld**	butt weld in the preparation for which the edge of one component 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
31 014	**double-J butt weld**	butt weld in the preparation for which the edge of one component is prepared so that in cross section the fusion face is in the form of two opposing Js and the fusion face of the other component is at right angles to the surfaces of the first component

No.	Term	Definition
31 015	**fillet weld**	fusion weld, other than a butt, edge or fusion spot weld, which is approximately triangular in transverse cross section (examples are shown in Figure 50.14, Figure 50.20, Figure 50.25, Figure 50.27, Figure 50.28, Figure 50.30, Figure 50.33, Figure 50.34 and Figure 50.35)
31 016	**tack weld**	weld used to assist assembly or to maintain alignment of edges during welding
31 017	**plug weld**	weld made by filling a hole in one component of a workpiece with filler metal so as to join it to the surface of an overlapping component exposed through the hole (see Figure 50.29)
31 018	**seal weld** sealing weld	weld intended primarily to provide tightness against leakage of gas or fluid
31 020	**edge weld**	weld in an edge joint, other than a seal weld, used for joining two or more parts and in which the weld metal covers part or the whole of the edge widths (see Figure 50.36)
31 021	**butt joint**	connection between the ends or edges of two parts making an angle to one another of 135° to 180° inclusive in the region of the joint (see Figures 50.1 to 50.18)
31 022	**T-joint**	connection between the end or edge of one part and the face of the other part, the parts making an angle to one another of more than 5° up to and including 90° in the region of the joint (see Figures 50.19 to 50.25)
31 026	**lap joint**	connection between two overlapping parts making an angle to one another of 0° to 5° inclusive in the region of the weld or welds (see Figures 50.28 to 50.31)
31 027	**corner joint**	connection between the ends or edges of two parts making an angle to one another of more than 30° but less than 135° in the region of the joint (see Figures 50.32 to 50.35)
31 028	**edge joint**	connection between the edges of two parts making an angle to one another of 0° to 30° inclusive in the region of the joint (see Figure 50.36)
31 031	**root face** nose: *deprecated*	portion of a fusion face at the root that is not bevelled or grooved (see Figure 51)
31 034	**feather edge**	edge formed at the root due to bevelling being carried through from one surface to the other
31 035	**land**	straight portion of a fusion face between the root face and the curved part of a J-edge preparation
31 036	**edge preparation** end preparation[7)]	surface prepared on the edge of a component to be welded
31 037	**toe** weld edge: *deprecated*	boundary between a weld face and the parent metal or between runs (see Figure 52) *NOTE The term "toe" should always be qualified according to whether it applies to the complete weld or to individual runs.*
31 038	**angle of bevel** angle of preparation: *deprecated*	angle at which the edge of a component is prepared for making a weld measured from the normal to the direction of the component (see Figure 51)

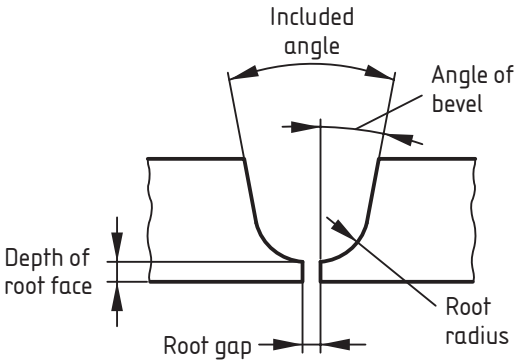
[7)] This term is applied only to strip and pipes or tubes.

No.	Term	Definition
31 040	**included angle** angle of preparation	angle between the planes of the fusion faces of parts to be welded (see Figure 51)
31 041	**root radius**	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 Figure 51)
31 043	**leg length** size	distance from the actual or projected intersection of the fusion faces and the toe of a fillet weld, measured across the fusion face (see Figure 52) *NOTE 1 For a 90° fillet weld having equal leg lengths, the term "size" has been used to mean leg length for a convex or mitre fillet weld or 1.4 times the design throat thickness for a concave fillet weld. In some applications "size" has been used to mean design throat thickness and therefore to avoid confusion "size" has been dropped as a preferred term.* *NOTE 2 In specifying a fillet weld the dimensions should now be clearly indicated as minimum leg length(s) or design throat thickness or both as appropriate.*

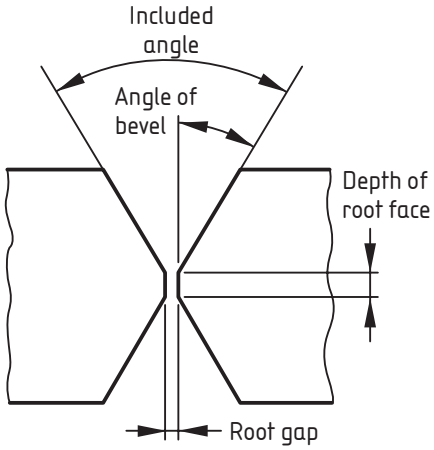
Figure 51 **Dimensions of root gap, root face, root radius, land, included angle and angle of bevel for typical weld preparations**



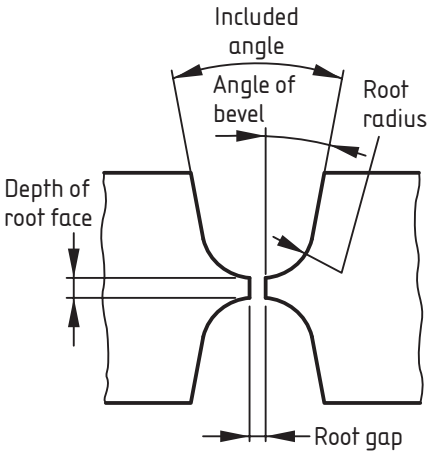
a) Single sided V-butt



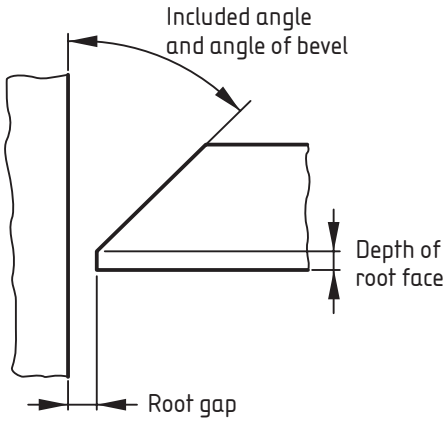
b) Single sided U-butt



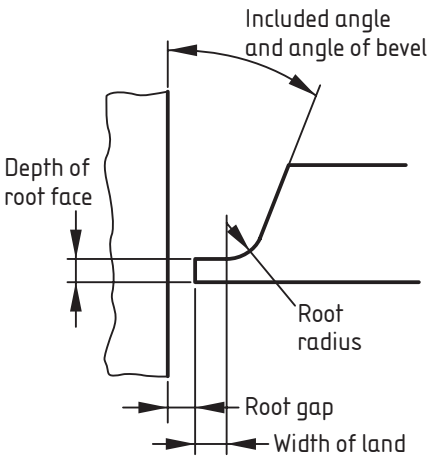
c) Double sided V-butt



d) Double sided U-butt



e) Single sided level T-butt



f) Single sided J T-butt

No.	Term	Definition
31 044	**actual throat thickness** throat thickness	*fillet welds*, the value of the height of the largest isosceles triangle that can be inscribed in the section of the finalized weld *butt welds*, the minimum distance from the surface of the part to the bottom of the penetration (for examples see Figure 53) *NOTE This is an arbitrary dimension that might not have particular relevance to design.*
31 045	**design throat thickness**	throat thickness specified by the designer (for examples see Figure 53)
31 046	**effective throat thickness**	minimum distance between the root and the cap in a completed weld *NOTE This may be used for assessment purposes.*
31 047	**weld width**	shortest distance between the outer toes of a weld face (see Figure 52)
31 050	**excess weld metal** reinforcement overfill	weld metal lying outside the plane joining the toes (see Figure 54)

Figure 52 **Examples of toes, legs, weld widths and fusion faces**

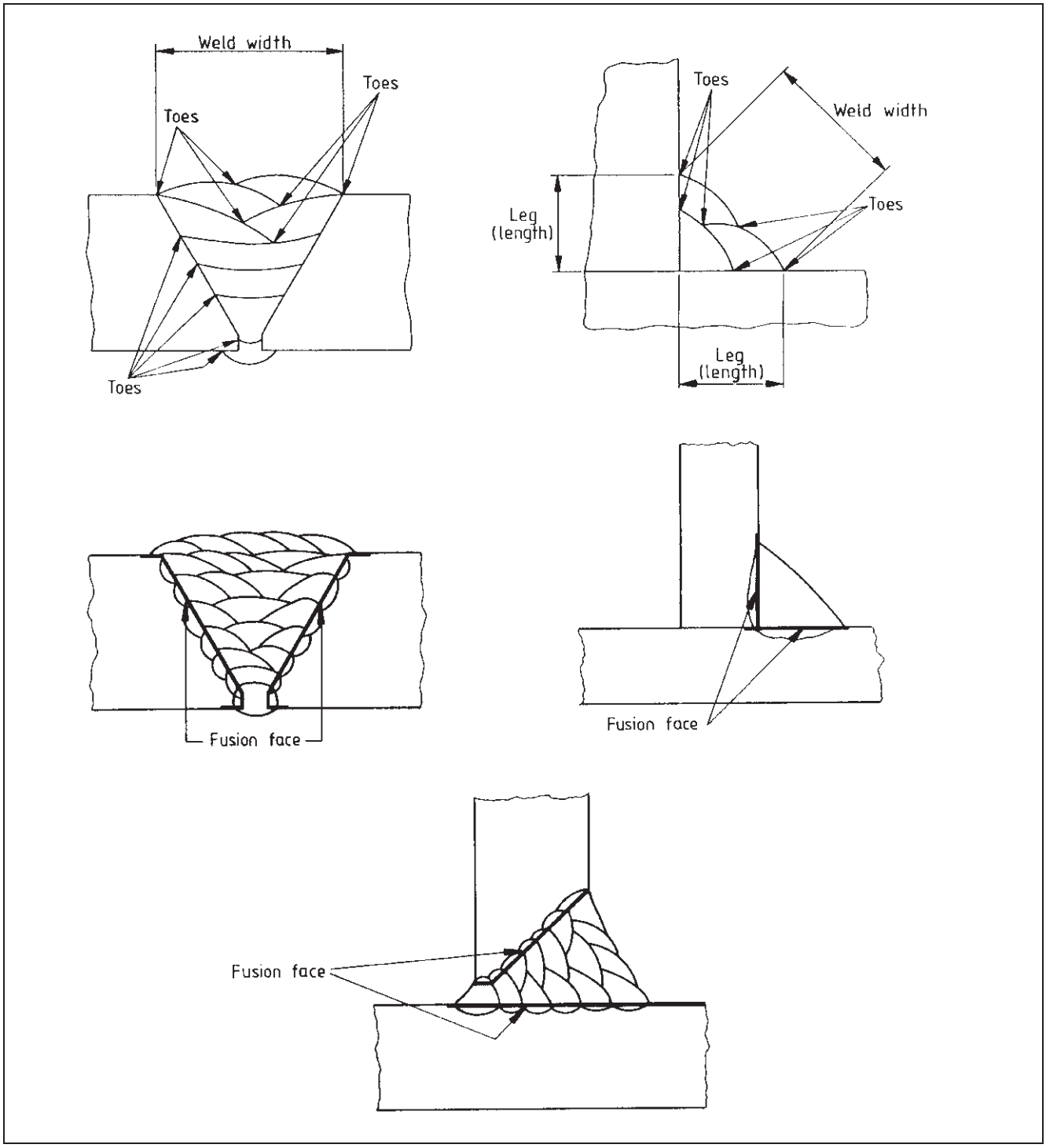
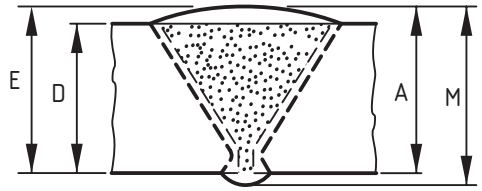
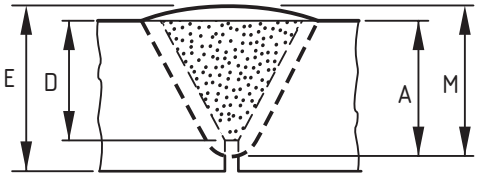


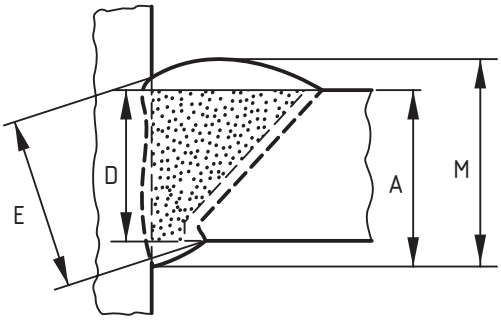
Figure 53 **Examples of actual, effective, design and maximum throat thickness of typical welds**



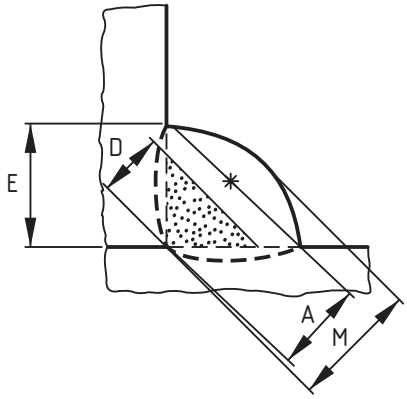
a) Full penetration single V butt with sealing run



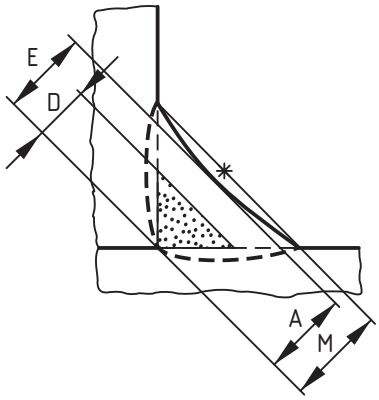
b) Partial penetration single V butt



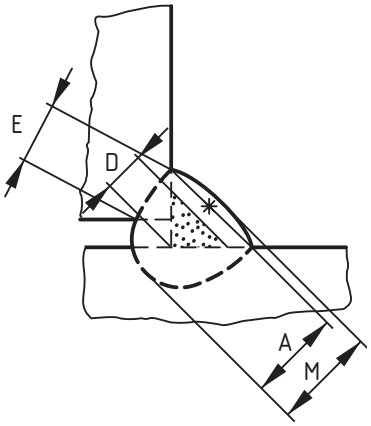
c) Full penetration single level T butt with sealing run



d) Convex fillet weld



e) Concave fillet weld



f) Fillet weld with root gap and root penetration

Key

– – – – – – Preparation face

Nominal weld zone

– – – – – – Actual fusion boundary

E Effective throat thickness

D Design throat thickness

——— Final joint surface

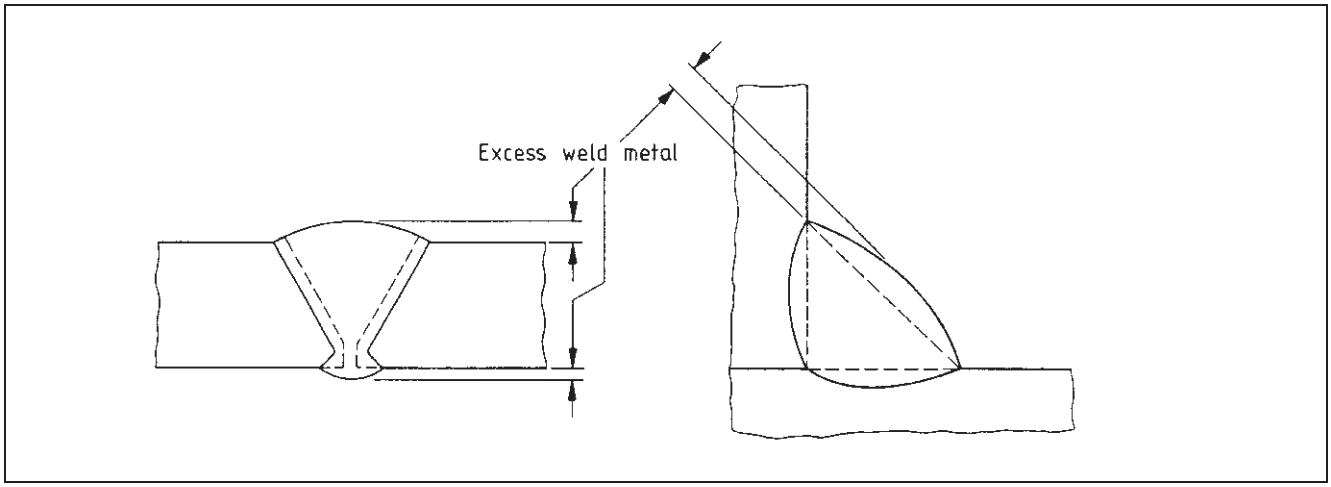
———✳——— Dimension line drawn through toes

A Actual throat thickness

M Maximum throat thickness

NOTE The positions of the dimension lines are shown correctly for the geometries illustrated but might vary for other cap and root profiles.

Figure 54 **Examples of excess weld metal**



No.	Term	Definition
31 051	**weld slope**[8)] *S*	*In the case of straight welds*, angle between the root line and the positive x-axis of the horizontal reference plane (see Figure 55); the slope, is measured in mathematically positive (i.e. counter-clockwise) direction *NOTE The co-ordination system is arranged so that the root line lies in the vertical reference plane, i.e. x/z-plane, (see Figure 55) and that the working direction radiates outward from the coordinate origin.* *In the case of curved welds, the same stipulation applies, the slope is obtained from the tangent to the root line, at the particular cross section of the weld in question and the x-axis.*
31 052	**weld rotation**[9)] *R*	angle between the centreline of the weld (i.e. the line joining the centres of the weld root at the capping layer) and the positive z-axis or a line parallel to the y-axis, measured in the mathematically positive (i.e. counter-clockwise) direction in the plane of the transverse cross section of the weld in question
31 053	**welding position**	orientation of a weld expressed in terms of working position, weld slope and weld rotation
31 054	**flat position** downhand position: *deprecated*	welding position in which the welding is horizontal, with the centreline of the weld vertical (see Table 1)
31 055	**horizontal vertical position**	welding position in which the welding is horizontal (see Table 1)
31 056	**vertical up position**	welding position in which the welding is upwards (see Table 1)
31 057	**vertical down position**	welding position in which the welding is downwards (see Table 1)

[8)] The main positions, defined by weld slope and weld rotation, are given in Table 1 and illustrated in Figure 57 and Figure 58. A comparison between the BS form of designation (based on the AWS/ANSI form) and the form given in ISO 6947 is shown in Figure 58. For the sake of clarity, symbols for the main working positions are given from the coordinate origin, the working direction being outwards.

[9)] This term is applied only to strip and pipes or tubes.

No.	Term	Definition
31 058	**horizontal overhead position**	welding position in which the welding is horizontal and overhead (see Table 1)
31 060	**horizontal position**	welding position in which the welding is horizontal, with the centreline of the weld horizontal (see Table 1)
31 061	**overhead position**	welding position in which the welding is horizontal and overhead, with the centreline of the weld vertical (see Table 1)
31 062	**inclined position**	any welding position not defined by the above positions, defined by slope and rotation
31 063	**manipulator** positioner	device to hold, tilt and rotate the workpiece to the desired position
31 064	**bead**	single run of weld metal on a surface

Table 1 **Terms and symbols for main welding positions** [A)]

Terms	Symbol	Weld slope *S*	Weld rotation *R*
31 054 Flat position	PA	0°	180°
		90°	90°
31 055 Horizontal vertical position	PB	0°	45°
		0°	135°
		180°	45°
		180°	135°
31 060 Horizontal position	PC	0°	0°
		0°	180°
		180°	0°
		180°	180°
31 058 Horizontal overhead position	PD	0°	225°
		0°	315°
		180°	225°
		180°	315°
31 061 Overhead position	PE	0°	270°
		180°	270°
31 056 Vertical up position	PF	90°	—
31 057 Vertical down position	PG	270°	—

NOTE 1 To avoid confusion with existing abbreviations, e.g. F for flat, in principle the letter "P" (for position) has been placed in front of the symbol to indicate "main position".

NOTE 2 Tolerances for the main positions are not specified in this British Standard because they depend on the different welding procedures used.

[A)] In accordance with ISO 6947.

Figure 55 **Welding positions: slope (*S*)**

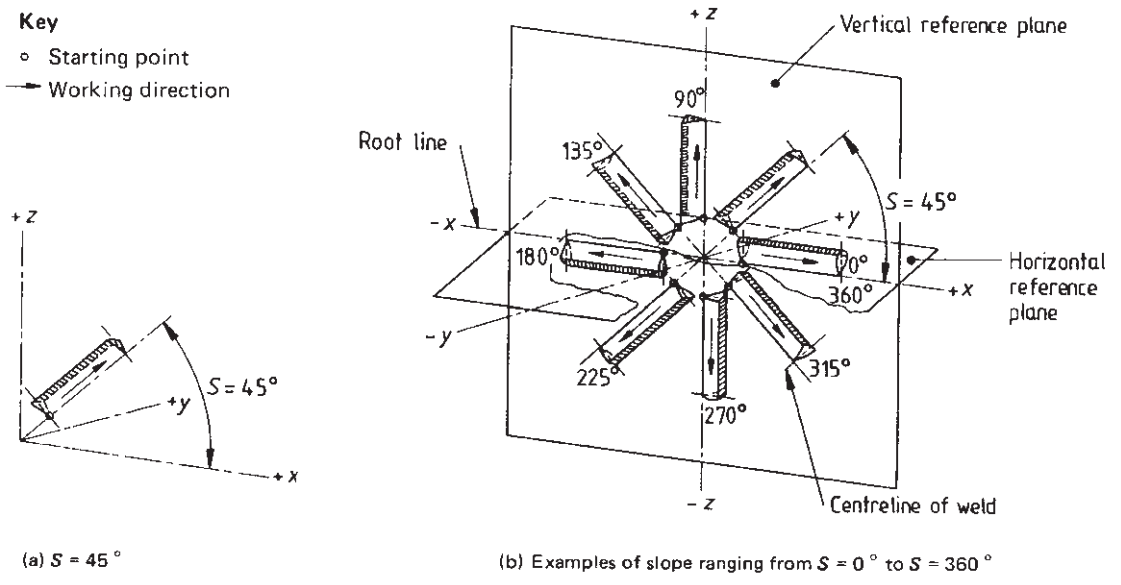


Figure 56 **Schematic diagram of main welding positions**

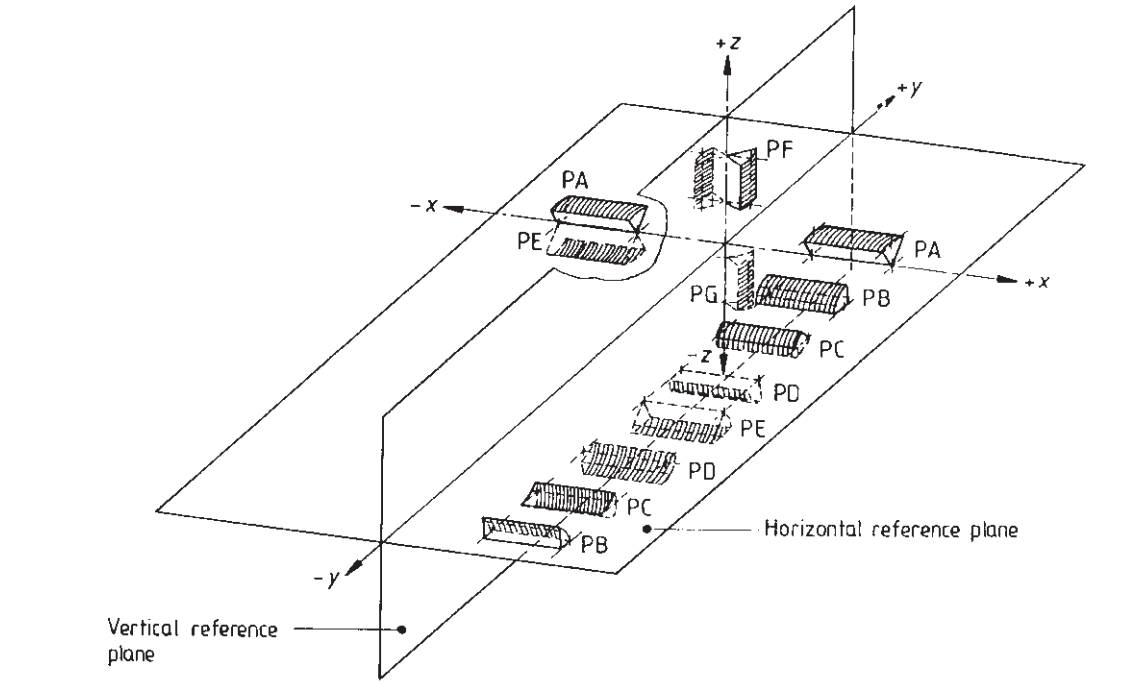


Figure 57 **Simplified view of main welding positions**

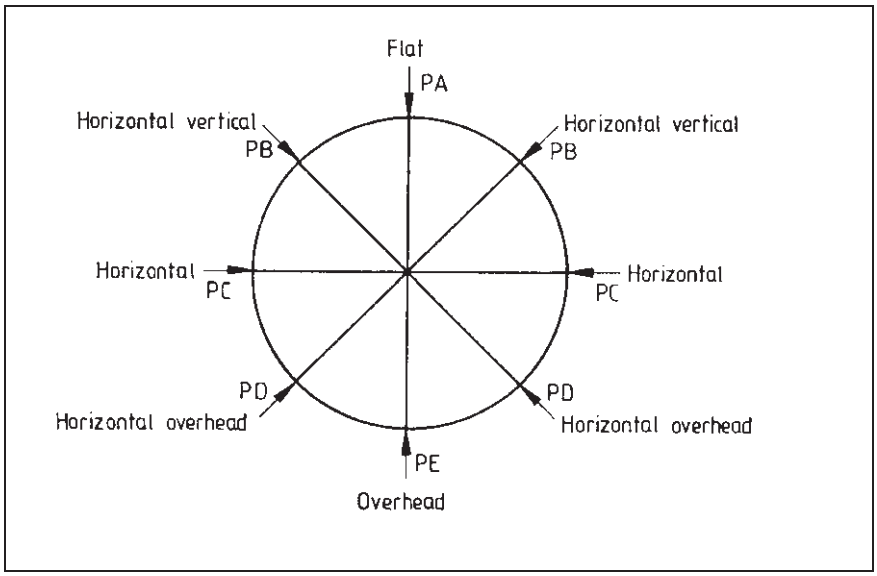


Figure 58 **Comparison of UK (USA) and ISO welding positions**

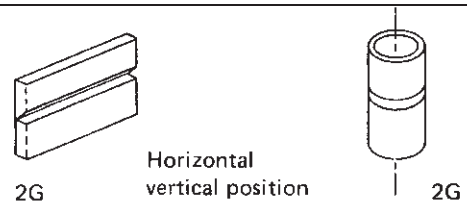
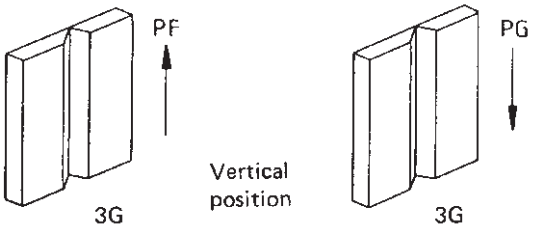
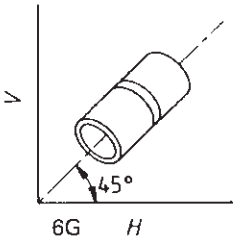
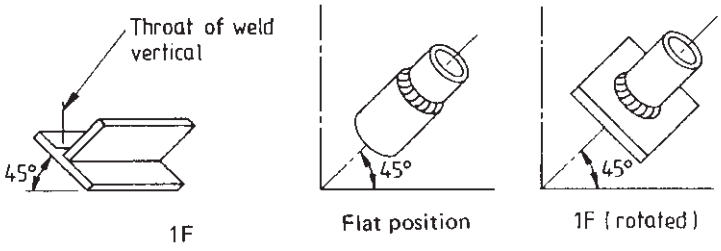
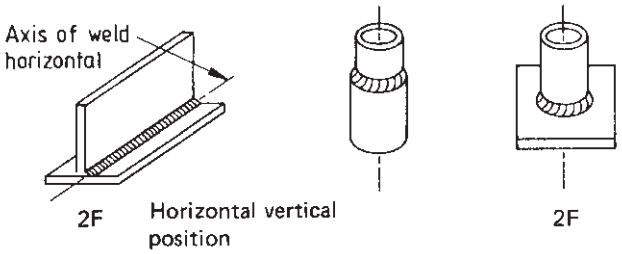
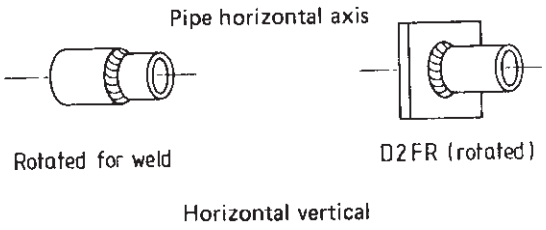
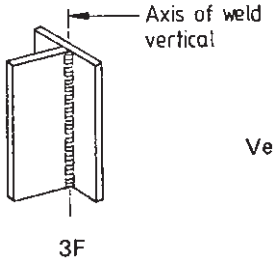
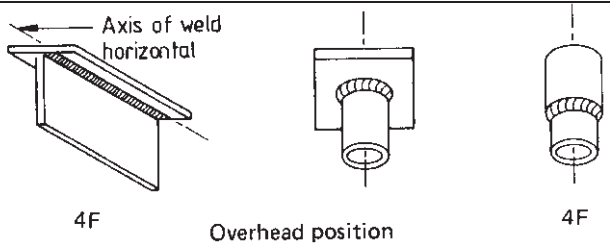
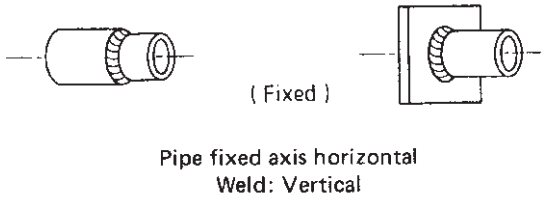
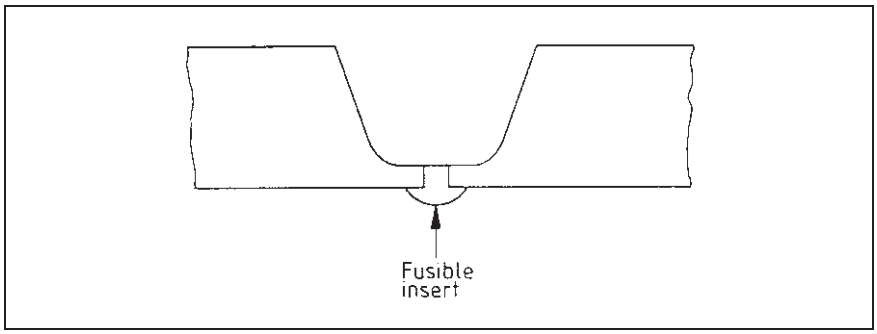
	UK (USA)	ISO
 1G rotated Flat position 1G	1G	PA
 2G Horizontal vertical position 2G	2G	PC
 PF 3G Vertical position PG 3G	3G	PF Vertical up PG Vertical down
 4G Overhead position	4G	PE
 Pipe fixed horizontal axis 5G Vertical position	5G	PF Vertical up PG Vertical down

Figure 58 **Comparison of UK (USA) and ISO welding positions** *(concluded)*

	UK (USA)	ISO
	6G	H-L045
	1F 1FR	L 45/PA L 45/PA
	2F	PB
	2FR	PB
	3F	PF Vertical up PG Vertical down
	4F	PD
	5F	PF Vertical up PF Vertical down

No.	Term	Definition
31 066	**full penetration welding**	welding using a technique which ensures that the weld metal fully penetrates the joint with complete root fusion
31 067	**partial penetration weld**	weld in which the fusion penetration is intentionally less than full penetration
31 068	**root run** root pass	first run deposited in the root of a multi-run weld
31 070	**sealing run**	final run deposited on the root side of a fusion weld *NOTE This should not be confused with term 31 018.*
31 071	**melt run**	line of parent metal that has been melted by passing a welding flame or arc along the surface of the metal
31 072	**weld pool**	pool of liquid metal formed during fusion welding *NOTE In electroslag welding the term includes the slag bath.*
31 073	**run-on plate**	piece of metal so placed as to enable the full section of weld metal to be obtained at the beginning of a joint
31 074	**run-off plate**	piece of metal so placed as to enable the full section of weld metal to be maintained up to the end of a joint
31 075	**permanent backing**	backing designed to remain permanently joined to the workpiece after welding (See Figure 50.8.) *NOTE It may remain as part of the joint or be removed by machining or other means.*
31 076	**permanent backing ring**	permanent backing inside a pipe, consisting of a continuous ring
31 077	**temporary backing**	backing designed to be removed from the workpiece after welding
31 078	**temporary backing ring**	temporary backing in the form of a ring
31 080	**fusible insert**	pre-placed filler material that is fused to aid the formation of a weld made from one side only (see Figure 59)

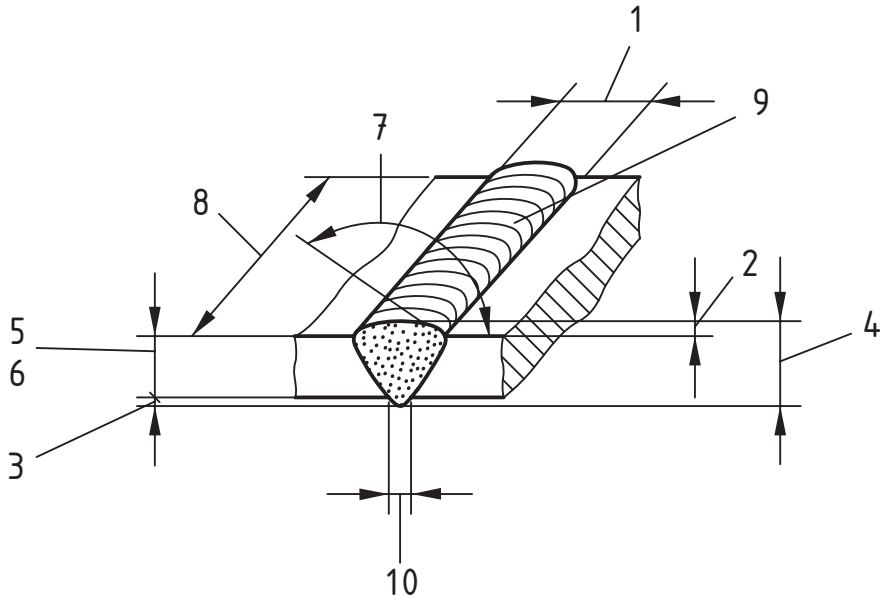
Figure 59 **Weld preparation using a fusible insert**



No.	Term	Definition
31 081	**welding speed**	*in fusion welding*, length of a single or multirun weld completed in a unit of time
31 082	**rate of travel** travel speed	time required to complete a unit length of a single run of weld or melt run
31 083	**slag**	non-metallic substance that results from fusion of an electrode covering, a flux core or a powdered flux and which, after solidification, partly or totally covers the weld metal

No.	Term	Definition
31 084	**wire guide** wire feed nozzle	part of an electro-slag or electro-gas welding machine that guides the electrode wire to the point of welding and also carries the electric current to the wire
31 085	**interpass temperature**	*In a multi-run weld*, temperature of the weld and adjacent parent metal immediately prior to the application of the next run
31 086	**stringer bead**	bead that is produced with no weaving motion of the filler rod or welding tool
31 087	**contact tube**	metal tube in a metal-arc or electro-slag welding head for passing welding current to, and for guiding, a wire electrode
31 088	**aluminothermic welding**	flow welding whereby the welding heat is obtained from reacting a mixture of metal oxides with finely ground aluminium powder whose ignition produces an exothermic reaction in which the molten metal produced is the filler metal
31 090	**electroslag welding**	fusion welding using the combined effects of current and electrical resistance in a consumable electrode, or electrodes, and a conducting bath of molten slag through which the electrode passes into the molten pool, both the pool and the slag bath being retained in the joint by cooled shoes which move progressively upwards (accompanied by a figure) *NOTE After the initial arcing period the end of the electrode is covered by the rising slag and then melts continuously until the joint is completed. Electrodes may be bare or flux cored strip(s) or plate(s).*
31 091	**gas backing**	protection of the root from the opposite side of the weld surface by using gas to prevent oxidation and to reduce the risk of a molten pool collapse
31 092	**gas flow rate**	rate of flow of shielding gas through a torch at normal temperature and pressure
31 093	**trailing gas shield**	additional supply of shielding gas protecting the weld and the weld area during cooling
31 094	**baking oven**	heated receptacle in which welding consumables are dried/ baked
31 095	**drying oven**	See **baking oven** (31 094).
31 096	**quiver**	portable, heated or non-heated, receptacle for holding or drying of covered electrodes
31 097	**tack sequence**	order in which tack welds are placed
31 098	**dilution**	alteration of composition of the metal deposited from a filler wire or electrode due to mixing with the melted parent material, usually expressed as the percentage of melted parent metal in the weld metal
31 100	**welding procedure requirements**	all the specified requirements in a welding procedure specification
31 102	**weld surface with bead ripples**	regular undulations of the weld surface (see Figure 60) *NOTE Illustration from BS EN ISO 17659.*
31 103	**back or front support**	piece of metal or other auxiliary material placed against the workpiece on either the back or front face of the joint in order to retain the molten weld metal

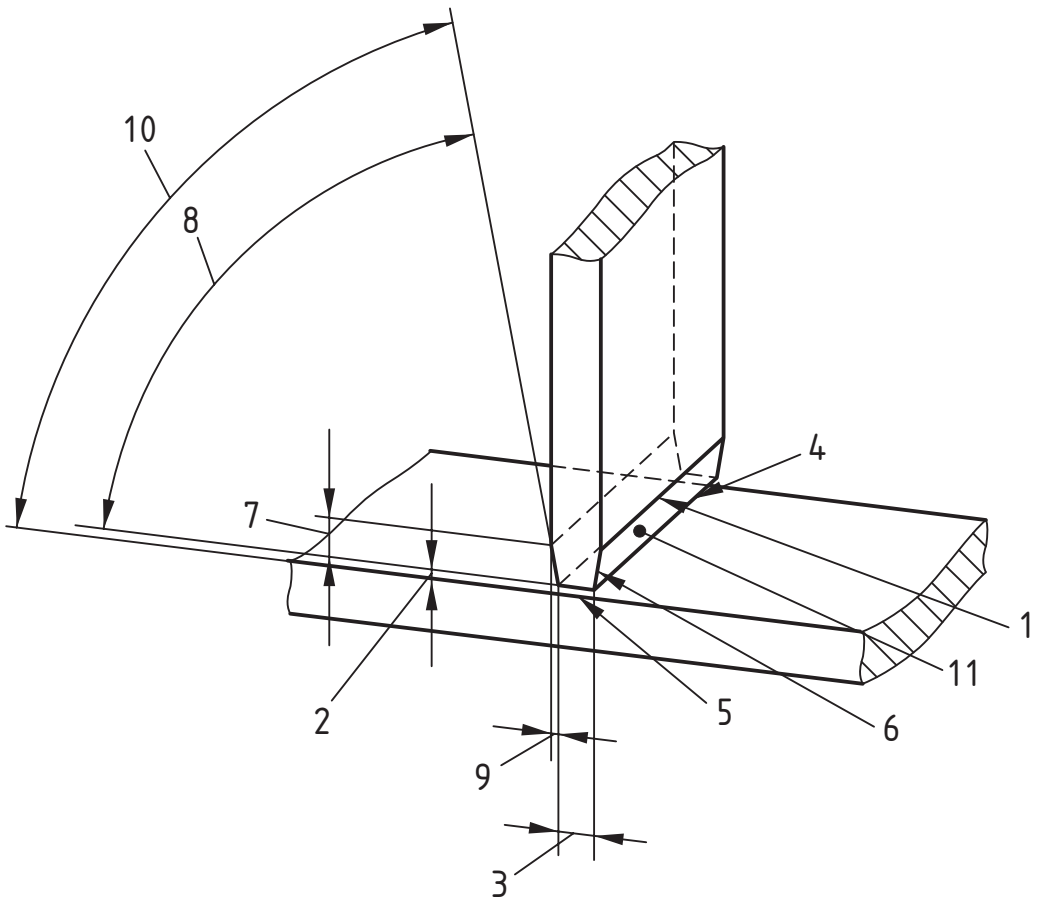
Figure 60 **Typical example of butt weld – General view of butt weld**



Key

1 Weld width
2 Excess weld metal
3 Penetration bead thickness
4 Maximum throat thickness
5 Design throat thickness
6 Actual throat thickness
7 Weld toe angle
8 Weld length
9 Weld surface with bead ripples
10 Root width

Figure 61 **Preparation for double-bevel T-butt welds**

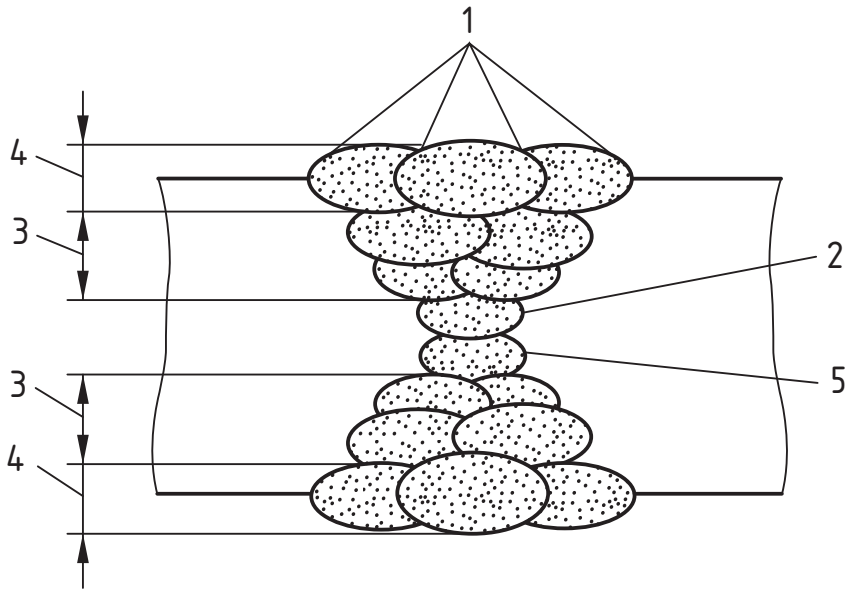


Key

1 Longitudinal edge of preparation
2 Root gap
3 Depth of root face
4 Longitudinal edge of root face
5 Side edge of root face
6 Side edge of preparation
7 Joint width
8 Angle of bevel
9 Depth of preparation
10 Included angle
11 Fusion face (prepared)

No.	Term	Definition
31 105	**capping run**	final run deposited on the top surface of a fusion weld
31 106	**depth of preparation**	distance between the workpiece surface and the root face, measured normal to the former (see Figure 61, item 9) *NOTE Illustration from BS EN ISO 17659.*
31 107	**depth of raised edge**	distance between the fusion face and the near side of the workpiece in a raised-edge butt joint (see Figure 6, item 5) *NOTE Illustration from BS EN ISO 17659.*
31 108	**depth of root face**	width of root face, measured normal to the workpiece surface (see Figure 7, item 3, Figure 10, item 3, and Figure 61, item 3) *NOTE Illustration from BS EN ISO 17659.*
31 109	**filling run(s)**	*in multi-layer welding*, run(s) deposited after the root run(s) and before the capping run(s)

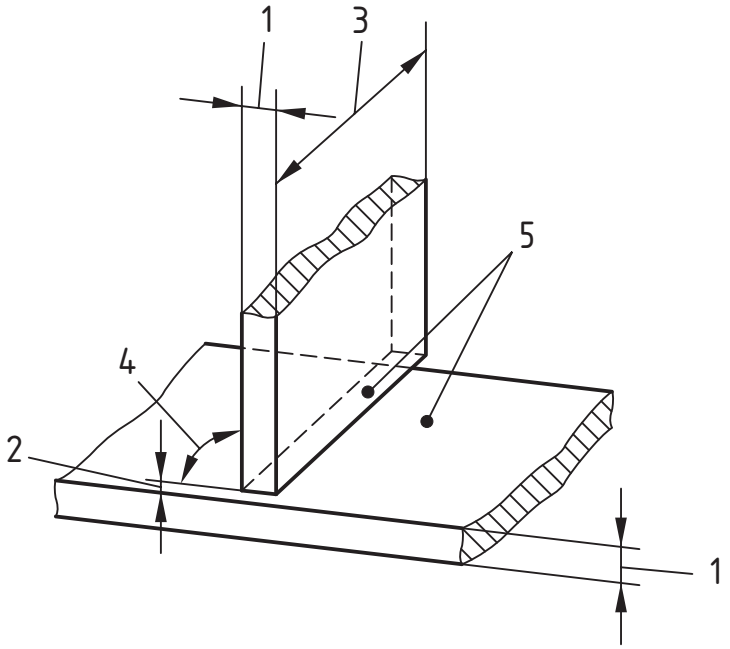
Figure 62 **Typical example of multi-run fusion weld – Double V-butt weld**



Key

1 Toe
2 Root run
3 Layers of filling runs
4 Layer of capping runs
5 First run on second side

Figure 63 **Preparation for fillet weld (T-joint)**

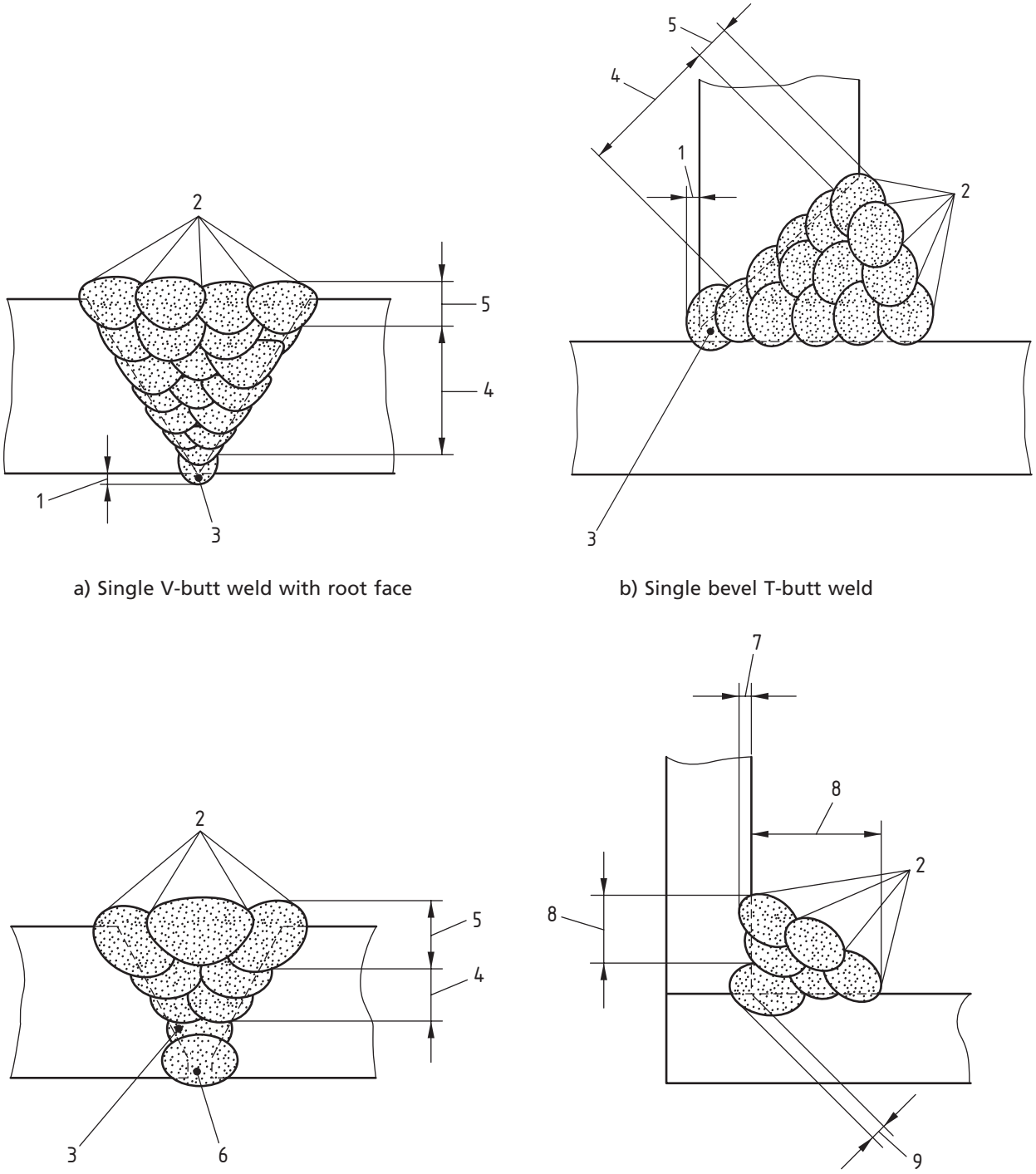


Key

1 Plate thickness
2 Root gap
3 Joint length
4 Included angle
5 Fusion face (fillet weld)

No.	Term	Definition
31 111	**fusion face (fillet weld)**	face of workpiece to be fused by a fillet weld (see Figure 61, item 11 and Figure 63, item 5) *NOTE Illustration from BS EN ISO 17659.*
31 112	**fusion face (prepared)**	fusion face of a weld preparation that has been prepared by cutting, grinding or machining (see Figure 7, item 8, Figure 10, item 11, Figure 61, item 11, and Figure 65, item 7) *NOTE Illustrations are from BS EN ISO 17659.*
31 113	**fusion face (unprepared)**	fusion face that does not require preparation (see Figure 5, item 8, Figure 6, item 7, and Figure 7, item 7) *NOTE Illustrations are from BS EN ISO 17659.*
31 114	**fusion penetration**	1) *In fusion welding*. depth to which the parent metal has been fused (See Figure 4.) 2) *In spot, seam or projection welding*. 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 Figure 17)
31 117	**layer of capping runs**	weld metal, deposited on the final surfaces of the joint [see Figure 62, item 4, Figure 64a), item 5, Figure 64b), item 5, and Figure 64c), item 5] *NOTE Illustrations are from BS EN ISO 17659.*
31 118	**layers of filling runs**	weld metal, deposited beneath the capping runs [see Figure 62, item 3, Figure 64a), item 4, Figure 64b), item 4, and Figure 64c), item 4] *NOTE Illustrations are from BS EN ISO 17659.*

Figure 64 **Typical examples of multi-run fusion welds**

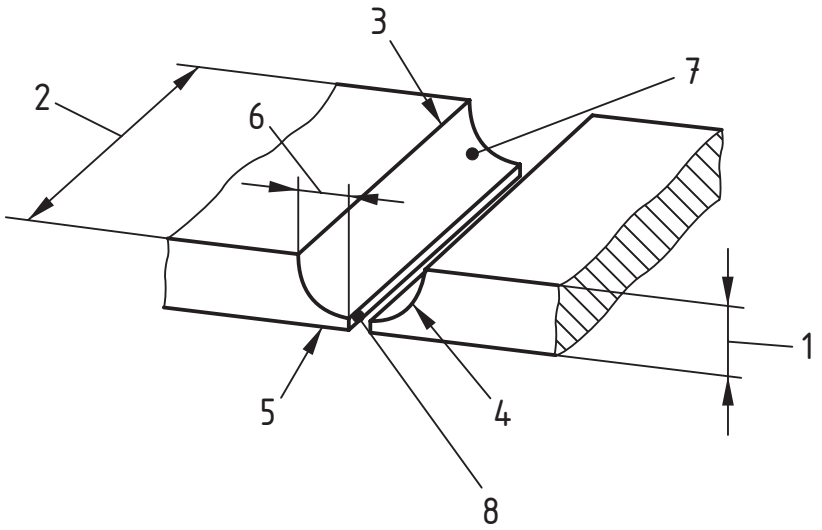


Key

1 Penetration bead thickness
2 Toe
3 Root run
4 Layers of filling runs
5 Layer of capping runs
6 Sealing run
7 Fusion penetration
8 Leg length
9 Root penetration

No.	Term	Definition
31 119	**length of raised edge**	length of the raised edge in the direction of the joint (see Figure 6, item 2) *NOTE Illustration from BS EN ISO 17659.*
31 120	**longitudinal edge of preparation**	junction of the fusion face and the upper workpiece surface (see Figure 61, item 1, and Figure 65, item 3) *NOTE Illustrations are from BS EN ISO 17659.*
31 121	**longitudinal edge of root face**	junction of the fusion face and the root face (see Figure 61, item 4) *NOTE Illustration from BS EN ISO 17659.*
31 122	**longitudinal side of raised edge**	junction of the upturned upper workpiece surface and the fusion face in a raised-edge bead weld (see Figure 6, item 3) *NOTE Illustration from BS EN ISO 17659.*
31 123	**penetration bead thickness**	height of the root bead above the reverse side of the workpiece [see Figure 64a), item 1, Figure 64b), item 1, and Figure 66, item 10] *NOTE Illustrations are from BS EN ISO 17659.*
31 124	**radius of raised edge**	radius of curved surface of a raised-edge butt weld (see Figure 6, item 6) *NOTE Illustration from BS EN ISO 17659.*

Figure 65 **Preparation for single U-butt weld**

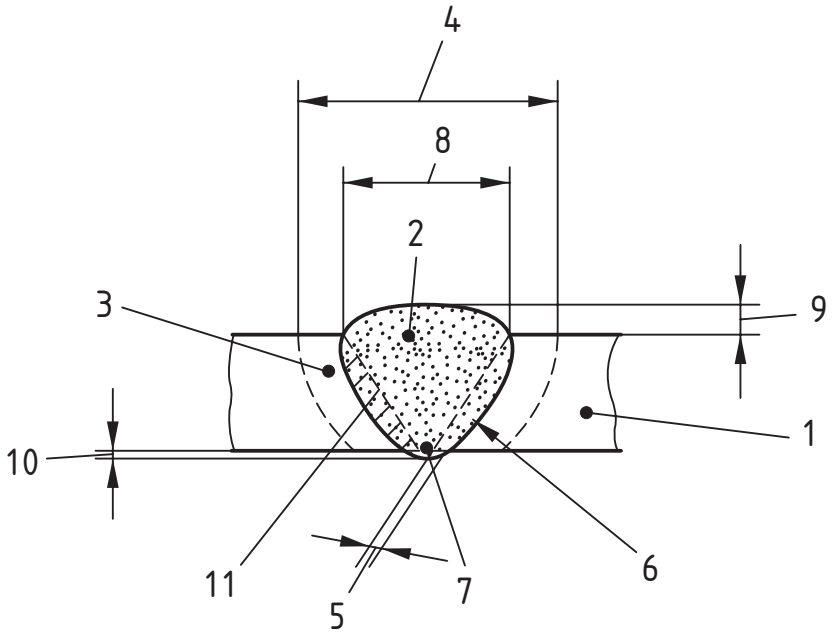


Key

1 Plate thickness
2 Joint length
3 Longitudinal edge of preparation
4 Root radius
5 Side edge of root face
6 Width of prepation
7 Fusion face (prepared)
8 Root face

NOTE For other dimensions see Figure 50.

Figure 66 **Typical example of fusion weld – Single V-butt weld**

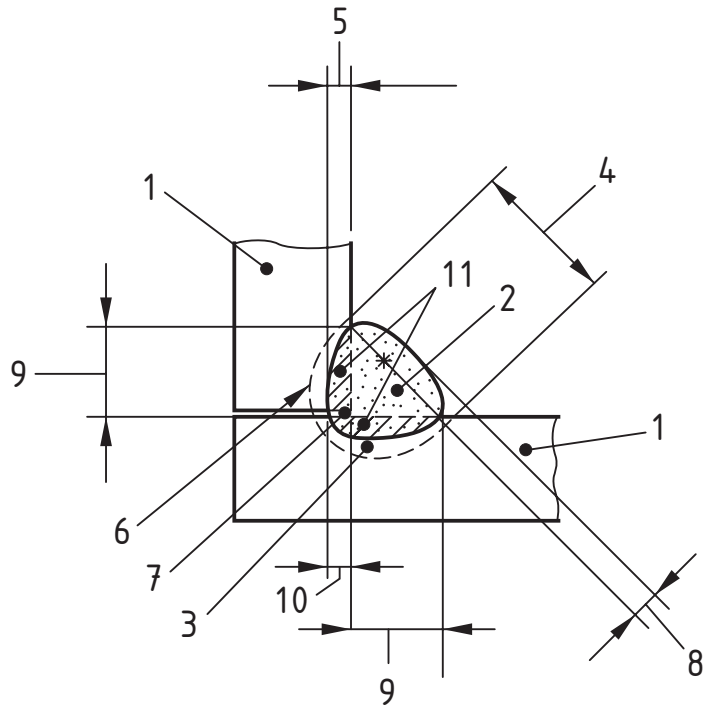


Key

1 Parent metal
2 Weld metal
3 Heat-affected zone
4 Weld zone
5 Fusion penetration
6 Fusion line
7 Root of weld
8 Weld width
9 Excess weld metal
10 Penetration bead thickness
11 Fusion zone

No.	Term	Definition
31 125	**root gap**	gap between the root faces *NOTE See also Figures 5, 7, 61, 63 and 65.*
31 126	**root (of weld)**	zone on the side of the first run farthest from the welder (see Figure 4, Figure 66, Figure 67 and also 31 179)
31 127	**root penetration**	distance of penetration of molten weld into the root zone [see Figure 64d), item 9, and Figure 67, item 10] *NOTE Illustrations are from BS EN ISO 17659.*

Figure 67 **Typical example of fusion weld – Fillet weld**



Key

1 Parent metal
2 Weld metal
3 Heat-affected zone
4 Weld zone
5 Fusion penetration
6 Extremity of HAZ
7 Root of weld
8 Excess weld metal
9 Leg length
10 Root penetration
11 Fusion zone

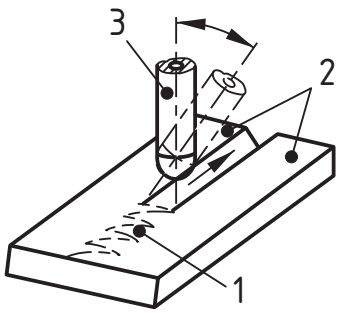
Weld medal
Fusion zone
Fusion boundary
Extremity of HAZ
Line between toes

No.	Term	Definition
31 128	**root width**	width of the root bead (see Figure 60, item 10) *NOTE Illustration from BS EN ISO 17659.*
31 129	**side edge of preparation**	junction of the end of the joint and the preparation (see Figure 10, item 5, and Figure 61, item 6) *NOTE Illustrations are from BS EN ISO 17659.*
31 130	**side edge of root face**	junction of the end of the end of the joint and the root face (see Figure 10, item 4, Figure 61, item 5, and Figure 65, item 7) *NOTE Illustrations are from BS EN ISO 17659.*
31 133	**weld toe angle**	angle between the upper workpiece surface and the tangent to the metal cap at the tow, in a plane normal to the weld axis (see Figure 60, item 7) *NOTE Illustration from BS EN ISO 17659.*
31 134	**width of preparation**	projected distance between the root face and the longitudinal edge of preparation, measured in the plane of the upper workpiece surface, normal to the weld axis (see Figure 10, item 6, and Figure 65, item 8) *NOTE Illustrations are from BS EN ISO 17659.*

No.	Term	Definition
31 135	**width of prepared face**	distance between the root face and the longitudinal edge of the preparation (see Figure 10, item 9) *NOTE Illustration from BS EN ISO 17659.*
31 136	**buttering**	overlay welding in a joint preparation to provide a suitable transition between the parent material and subsequent welds
31 137	**cosmetic run** **cosmetic pass**	pass for superficial remelting of the weld in order to enhance appearance
31 138	**slope-down**	1) controlled gradual decrease of the current in slope control 2) *in beam welding*, controlled decrease of the beam power at the end of welding
31 139	**slope-up**	1) controlled gradual increase of the current in slope control 2) *in beam welding*, controlled increase of the beam power at the beginning of welding
31 140	**tacking run** **tacking pass**	*in beam welding*, pass made to hold the parts to be welded in proper alignment until the final welds are made
31 141	**tack welding**	fixing of workpieces or assemblies to be joined in their proper position by weld spots or short lengths of weld
31 143	**slot lap joint** slot weld	joint between two overlapping components made 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 Figure 50.30.)
31 144	**backing** **weld pool backing**	material placed at the reverse side of a joint preparation for the purpose of supporting molten weld metal; it may also be used to assist formation of the root run
31 145	**both-side welding**	welding in which the weld is made from both sides of the workpiece
31 146	**double-side single-run welding**	welding in which the weld is made from both sides of the workpiece in one run, each run consisting of one bead only
31 147	**keyhole technique**	welding technique in which concentrated heat penetrates through a workpiece, forming a hole (keyhole) at the leading edge of the weld pool *NOTE As the heat source progresses, the molten metal fills the keyhole.*
31 148	**multi-run welding**	welding in which the weld is made or layer deposited in more than two runs *NOTE It may also be designated according to the number of runs (e.g. three-run welding).*
31 149	**one-side welding**	welding in which the weld is made from one side of the workpiece
31 150	**shielding gas**	protective gas used to prevent or reduce atmospheric contamination
31 151	**simultaneous double side welding**	welding in which the weld is made from both sides of the workpiece in one run simultaneously, each run consisting of one bead only
31 152	**single-run welding**	welding in which the weld is made or layer is deposited in one run *NOTE The weld may consist of one or a number of beads.*

No.	Term	Definition
31 154	**temporary weld**	weld made to attach a piece or pieces to a weldment for temporary use in handling, shipping, or restraining the joint during welding
31 155	**thermal efficiency**	*for linear welds,* ratio of heat divided by arc energy (see 10 064 and 32 116)
31 156	**weave bead**	bead that is produced with a weaving motion of the filler rod or welding tool
31 157	**weave technique**	welding technique where the run is produced by oscillating the torch transverse to the direction of welding (see Figure 68)

Figure 68 **Weave technique**



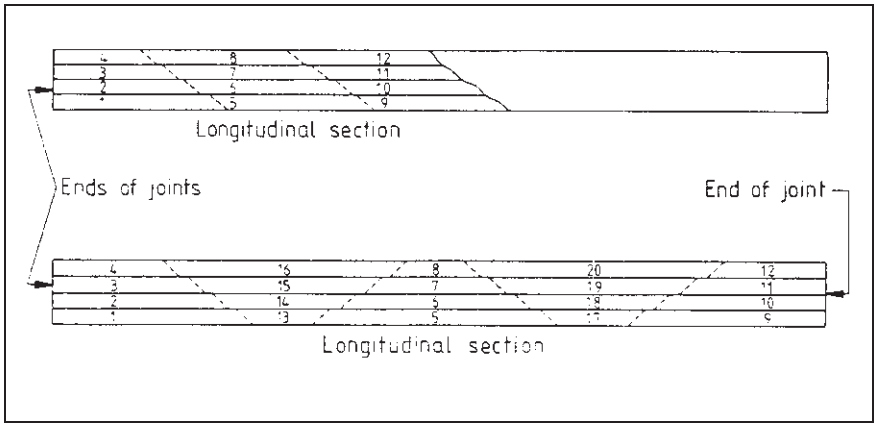
Key
1 Weld
2 Torch
3 Workpiece

No.	Term	Definition
31 158	**weaving amplitude**	half the weaving width
31 159	**weaving frequency**	number of oscillatory movements of filler rod or welding tool per unit time
31 160	**weaving width**	transverse extent of weaving
31 161	**beam welding**	fusion welding processes using a focused beam of high energy radiation
31 162	**skip sequence** skip welding; wandering sequence	welding sequence in which short lengths of run are spaced in scattered positions in predetermined order eventually to produce a continuous or intermittent weld, the lengths being laid in either longitudinal direction (see Figure 69)

Figure 69 **Example of skip sequence**

No.	Term	Definition
31 163	**block sequence** block welding	welding sequence in which short lengths of the weld are each made by superimposing a number of runs up to the full or partial size of the weld to form a block before proceeding with the next block; these blocks may be adjacent or spaced (see Figure 70)

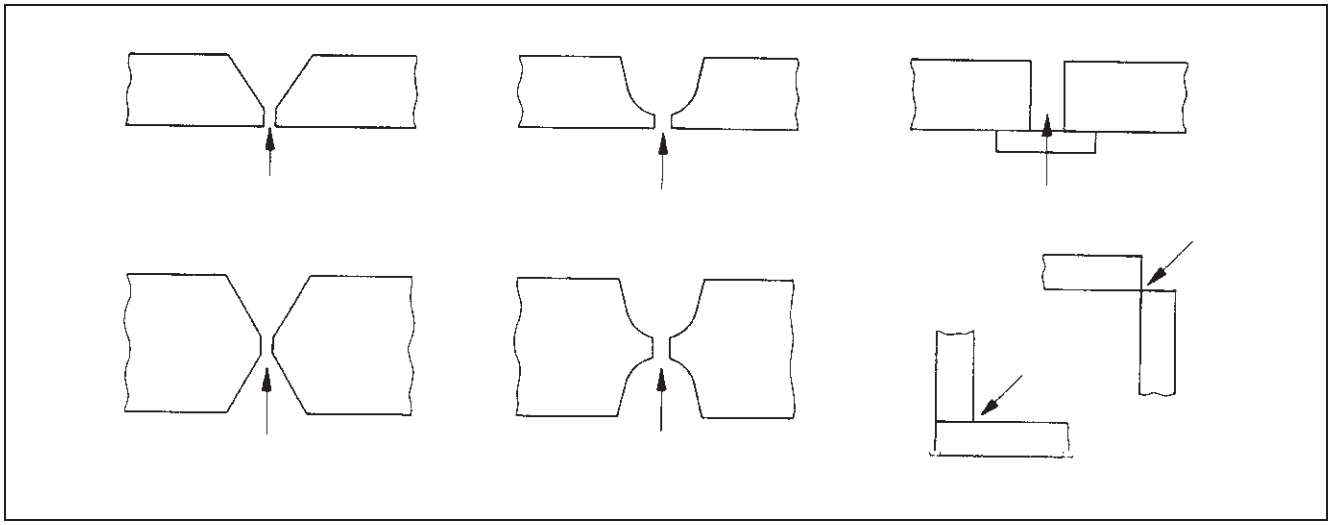
Figure 70 **Examples of block sequences**



No.	Term	Definition
31 164	**chain intermittent weld**	intermittent weld on each side of a joint (usually fillet welds in T and lap joints) arranged so that the welds lie opposite to one another along the joint
31 165	**single-bevel butt weld**	butt weld in the preparation for 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 Figure 50.15, Figure 50.16, Figure 50.19, Figure 50.24 and Figure 50.32)
31 166	**double-bevel butt weld**	butt weld in the preparation for 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 Figure 50.21, Figure 50.23 and Figure 50.26)
31 167	**flat face fillet weld**	fillet weld in which the weld face is approximately flat
31 168	**mitre fillet weld**	flat face fillet weld in which the leg lengths are equal within the agreed tolerance
31 169	**convex fillet weld**	fillet weld in which the weld face is convex
31 170	**concave fillet weld**	fillet weld in which the weld face is concave
31 171	**fusion spot weld**	weld, other than a plug weld or slot lap joint, produced by fusion welding at a spot in the workpiece through one or more thicknesses of overlapping parts (see Figure 50.31)
31 172	**flush weld**	weld in which the weld face follows approximately the contour of the parent material
31 173	**tapered member** chamfered member: *deprecated*	member whose thickness is tapered down to suit that of another member
31 174	**closed joint preparation**	preparation in which the components to be joined are substantially in contact before welding
31 175	**open joint preparation**	preparation in which the components to be joined are separated by a specific gap before welding

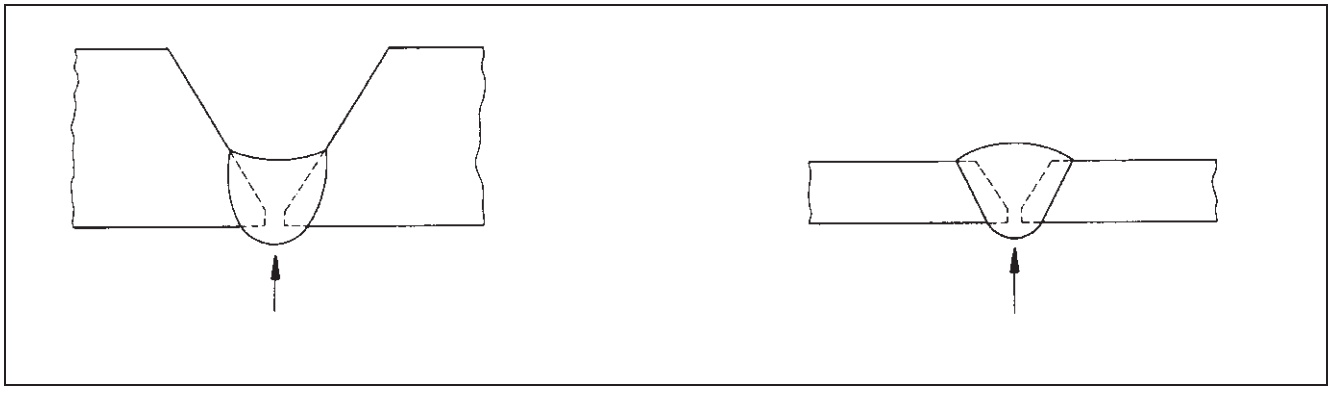
No.	Term	Definition
31 176	**cruciform joint**	connection in which two flat plates or two bars are welded to another flat plate at right angles and on the same axis (see Figure 50.26 and Figure 50.27)
31 177	**weld face**	surface of a fusion weld exposed on the side from which the weld has been made (see Figure 52)
31 178	**fusion face**	surface of the parent metal to be melted during welding
31 179	**root (of preparation)**	1) *In the preparation of V, U, J and bevel butt welds*. zone in the neighbourhood of, and including, the gap 2) *In a square butt weld with backing bar or strip*. zone between the prepared edges adjacent to a backing bar or strip 3) *In parts assembled for fillet welding*. zone in the neighbourhood of the actual or projected intersection of the fusion faces (see Figure 71 and also term 31 126)

Figure 71 **Roots of typical weld preparations**



No.	Term	Definition
31 180	**leg**	width of a fusion face in a fillet weld
31 181	**effective length**	length of continuous weld of specified dimension
31 182	**penetration bead**	weld metal protruding through the root of a fusion weld made from one side only (see Figure 72)

Figure 72 **Penetration bead**



No.	Term	Definition
31 183	**penetration run** penetration pass	first run or pass of a multi-run weld whose penetration bead can be seen
31 184	**molten pool** weld pool	pool of liquid metal formed during fusion welding *NOTE In electroslag welding the term includes the slag bath.*
31 185	**weaving**	transverse oscillation of an electrode or of a blowpipe nozzle during the deposition of weld metal
31 186	**chipping hammer**	hand hammer designed for the removal of slag from weld deposits
31 187	**transfer efficiency**	degree to which allowing elements in a filler metal or electrode are transferred to the weld metal, usually expressed as the ratio of the percentage of the element in an undiluted weld metal pad to the percentage originally present in the filler wire or electrode *NOTE Loss of alloying elements in this case is due to volatilization, oxidation or reaction with the flux and not that due to dilution.*
31 188	**shoe**	part of an electro-slag or electro-gas welding machine that serves to retain the pool of molten metal and slag in the joint
31 189	**cross bar** gap bar; slitter bar: *deprecated*	member in an electro-slag or electro-gas welding machine that passes through the gap above the weld pool in order to support the far-side shoe
31 190	**end tapering**	operation in which the end(s) of a run is gradually tapered to ensure that subsequent runs can be effected without incurring any lack of root or interpass fusion
31 191	**stringer bead**	weld bead deposited without weaving motion of the electrode or filler material
31 192	maximum throat thickness: *deprecated*	dimension measured from the deepest point of the penetration in fillet welds or the extremity of the root run in butt welds to the highest point of the excess weld metal (see Figure 60, item 4) *NOTE This is usually measured from a cross-section, but is not normally used in design or the specification of quality.*

Subsection 32. Terms relating only to arc welding

No.	Term	Definition
32 001	**arc welding**	fusion welding in which heat for welding is obtained from an electric arc or arcs
32 002	**metal-arc welding**	arc welding using a consumable electrode
32 003	**manual metal-arc welding** MMA welding	manually operated metal-arc welding using a covered electrode
32 004	**carbon-arc welding**	arc welding using a carbon electrode or electrodes
32 005	**metal active-gas welding** MAG welding	gas-shielded metal-arc welding in which the shielding is provided by a chemically active gas
32 006	**metal inert-gas welding** MIG welding	gas-shielded metal-arc welding in which the shielding is provided by an inert gas, e. g. argon or helium
32 007	**tungsten inert-gas welding** TIG welding	gas-shielded arc welding using a non-consumable pure or activated tungsten electrode where the shielding is provided by a shroud of inert gas

No.	Term	Definition
32 008	**submerged-arc welding** SA welding	metal-arc welding in which one or more wire electrode(s) [or tubular-cored electrodes], or strip electrode(s) are used, the arc(s) being completely enveloped by molten slag which fuses from the granular flux that is deposited loosely
32 010	**electro-gas welding**	arc welding using a gas-shielded consumable electrode to deposit metal into a molten pool, retained in the joint by cooled shoes which move progressively upwards as the joint is made
32 011	**arc spot welding**	arc welding in which overlapping parts are joined by fusing through one component into the other and so producing a fusion weld at the faying surfaces
32 012	**metal-arc spot welding**	manual arc spot welding using a covered electrode
32 013	**MIG spot welding** inert-gas consumable electrode spot welding	arc spot welding using a bare consumable electrode with the arc and molten pool shielded by gas that is wholly or mostly inert
32 014	**TIG spot welding** inert-gas tungsten-arc spot welding	arc spot welding using a tungsten electrode with the arc and molten pool shielded by gas that is wholly or mostly inert
32 015	**arc stud welding**	arc welding process that uses an arc between a metal stud, or similar part, and the workpiece
32 016	**electrode** arc welding electrode	rod, tube or wire of metal or a rod of carbon between one end of which and either the work or another electrode the arc is formed *NOTE This should not be confused with term 22 015.*
32 017	**non-consumable electrode**	electrode that does not provide filler metal
32 018	**consumable electrode**	filler material that conducts the welding current
32 020	**covered electrode**	consumable electrode in the form of a rod consisting of a metallic core to which a covering has been applied
32 021	**tubular cored electrode**	wire electrode in a tubular form
32 022	**cored electrode** **flux cored electrode** flux-cored wire: *deprecated*	consumable electrode having a core of flux or other materials *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.*
32 023	**metal cored electrode**	metal cored electrode containing metal powder
32 024	**rutile electrode**	covered electrode in which the covering contains a high proportion of titanium dioxide
32 025	**cellulosic electrode**	covered electrode in which the covering contains a high proportion of cellulose
32 026	**basic electrode** low hydrogen electrode: *deprecated*	covered electrode in which the covering is based on calcium carbonate and fluoride
32 027	**hydrogen controlled electrode**	covered electrode that, when used correctly, produces less than a specific amount of diffusible hydrogen in the deposit
32 028	**iron powder electrode**	covered electrode in which the covering contains a high proportion of iron powder giving a deposition efficiency of at least 100%
32 030	**acid electrode**	covered electrode in which the covering contains a high proportion of acid material

No.	Term	Definition
32 031	**contact electrode** touch type electrode	covered electrode with a special covering that enables it to be kept in contact with the parent material during welding to facilitate control of arc length
32 032	**welding head**	1) device used in automatic arc welding plants comprising an electrode feed mechanism and means for conveying current to the electrode *NOTE It can include electrode straightening gear and can be stationary while the work is in motion or vice versa.* 2) *in resistance welding*, device comprising the force generation and guiding system carrying an electrode holder, platen or electrode wheel head
32 033	**arc voltage**	voltage between electrodes or between an electrode and the work, measured at a point as near as practicable to the arc
32 034	**striking voltage**	minimum voltage at which any specific arc may be initiated
32 035	**no-load voltage** open circuit voltage	voltage, exclusive of any arc striking or arc stabilizing voltage, between the output terminals of a welding power source when the external welding circuit is open and when the rated supply voltage is applied to the input terminals
32 036	**arc welding power source** arc welding plant	equipment for supplying current and voltage and having the required characteristics suitable for arc welding and allied processes
32 037	**constant-voltage welding power source**	1) arc welding power source whose terminal voltage remains substantially constant between full load and no load 2) arc welding power source with a flat characteristic
32 038	**drooping characteristic welding power source**	arc welding power source with a drooping characteristic
32 040	**welding converter**	arc welding power source consisting of an electric motor and a d.c. welding generator
32 041	**welding rectifier**	arc welding power source consisting of a static converter for supplying direct current for welding from an a.c. supply
32 042	**inverter welding power source**	power source that converts d.c. to a.c., which is rectified to d.c. by a low-weight transformer
32 043	**arcing time**	time during which the welding arc is maintained
32 044	**main arc** power arc: *deprecated*	arc that supplies welding heat for arc welding
32 045	**pilot arc**	low-intensity arc to facilitate the striking of the main arc
32 046	**gas shield**	layer of gas surrounding the weld zone to facilitate the making of a weld
32 047	**torch**	device that conveys all services necessary to the arc for welding, cutting or allied processes (for example current, gas, coolant, wire electrode)
32 048	**welding gun**	torch with a handle substantially perpendicular to the torch body
32 050	**plasma torch** plasma gun: *deprecated*	arc welding torch using a non consumable electrode and having a gas nozzle producing a constricted plasma arc
32 051	**torch angle**	angle between the electrode axis and the longitudinal axis of the unwelded part of the joint

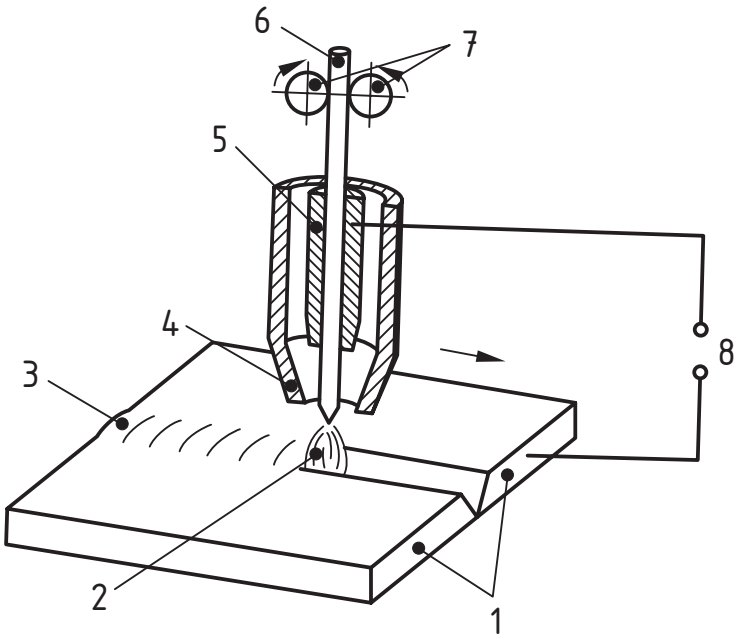
No.	Term	Definition
32 052	**electrode extension**	distance between end of contact tube and end of wire electrode
32 053	**metal transfer**	transfer of metal across the arc from a consumable electrode to the molten pool
32 054	**globular transfer**	metal transfer which takes place as globules of diameter substantially larger than that of the consumable electrode from which they are transferred
32 055	**spray transfer** droplet transfer	metal transfer which takes place as a rapidly projected stream of droplets of diameter not larger than that of the consumable electrode from which they are transferred
32 056	**particle transfer frequency**	frequency with which metal globules or droplets are transferred across the arc from the end of a consumable electrode
32 057	**dip transfer**	method of metal-arc welding in which fused particles of the electrode wire in contact with the molten pool are detached from the electrode in rapid succession by the short-circuit current which develops every time the wire touches the molten pool
32 058	**nominal electrode efficiency**	*for a covered electrode*, ratio of the mass of weld metal deposited under standard conditions to the mass of nominal diameter core wire consumed
32 060	**wire feed rate**	length of wire consumed per unit time
32 061	**stub end**	part of an electrode used in manual metal-arc welding that is discarded after deposition of the electrode's practicable length
32 063	**wandering arc**	arc that is unstable and does not maintain its directionality
32 064	**pulsed MIG welding**	MIG welding using a pulsed current
32 065	**pulsed TIG welding**	welding process in which a low background current maintains an arc with minimum heat input and a higher pulsed current occurring at a frequency of 1 Hz to 10 Hz; the pulse current melts a series of overlapping spots with very precise control of the heat input
32 066	**plasma arc welding** arc plasma welding	arc welding in which the heat for welding is produced with a constricted arc between either an electrode and the workpiece (a transferred arc); or between an electrode and the constricting nozzle (a non-transferred arc); plasma being generated by the hot ionized gases issuing from the orifice and supplemented by an auxiliary source of shielding gas
32 067	**arc welding transformer**	transformer designed to provide electrical energy for one or more welding arcs
32 068	**d.c. welding generator**	direct-current generator designed for providing electrical energy to one or more welding arcs
32 070	**a.c. welding generator**	alternating-current generator designed for providing electrical energy to one or more welding arcs
32 071	**engine driven power source**	arc welding set consisting of a generator and an engine, which are directly coupled, for supplying electrical energy for welding
32 072	**static characteristic**	relationship between the output current of a welding power source and the voltage across a practically non-inductive load connected to the output terminals

No.	Term	Definition
32 073	**dynamic characteristic**	change with time of voltage and current in response to alterations in load, as when initiating a weld
32 074	**arc blow**	lengthening or deflection of a welding arc caused by an asymmetric distribution of magnetic flux around the arc
32 075	**arc length**	distance from the tip of the welding electrode to the adjacent surface of the weld pool
32 076	**gravity welding with covered electrode**	metal-arc welding using an electrode supported by a mechanism that allows the electrode to descend and move along the joint under gravity
32 077	**gas-shielded arc welding**	arc welding in which the arc and molten pool are shielded from the atmosphere by an envelope of gas supplied from an external source
32 078	**gas-shielded metal-arc welding**	metal-arc welding using either a bare wire or cored electrode in which the arc and molten pool are shielded from the atmosphere by an envelope of gas supplied from an external source
32 080	**micro-plasma arc welding**	plasma arc welding at welding currents generally below 10 A
32 081	**strip cladding**	surfacing by automatic submerged-arc or gas-shielded arc welding in which the electrode is in the form of a strip
32 082	**deposition efficiency** metal recovery	ratio of the mass of weld metal deposited under specified conditions[10] to the total mass of electrode consumed, exclusive of the stub end, expressed as a percentage
32 083	**deposition coefficient**	*For a given electrode*, mass of weld metal deposited under standard conditions per ampere/minute
32 084	**effective electrode efficiency**	*For a covered electrode*, ratio of the mass of weld metal deposited under standard conditions to the mass of actual core wire consumed
32 085	**overall weld metal recovery**	*For covered electrodes*, ratio of the mass of weld metal deposited under standard conditions to the total mass of the electrode tested
32 087	**melting rate** **burn-off rate**	1) *In friction welding*. rate of shortening of the components during application of the friction force 2) *In arc welding*. linear rate of consumption of a consumable electrode
32 089	**backing gas**	gas used for gas backing
32 090	**narrow gap welding**	fusion welding in which the gap between the workpieces is relatively narrow; it can be carried out by different metal-arc welding processes, e.g. metal-arc active gas welding, electro-gas welding, etc.
32 091	**plasma MIG welding**	combination of MIG welding and plasma arc welding
32 092	**powder plasma welding**	plasma-arc welding with metallic powder feeding (accompanied by a figure)
32 093	**pull technique**	welding technique where the torch is pulled in the welding direction (accompanied by a figure in ISO 857-1) *NOTE The torch angle is less than or equal to 90°.*

[10] These conditions are normally specified by the electrode manufacturer.

No.	Term	Definition
32 094	**push technique**	welding technique where the torch is pushed in the welding direction (accompanied by a figure in ISO 857-1) *NOTE The torch angle is greater than 90°.*
32 095	**self-shielding tubular-cored arc welding**	metal-arc welding using a tubular-cored electrode without external shielding gas (see Figure 73)

Figure 73 **Self-shielded tubular-cored arc welding**



Key

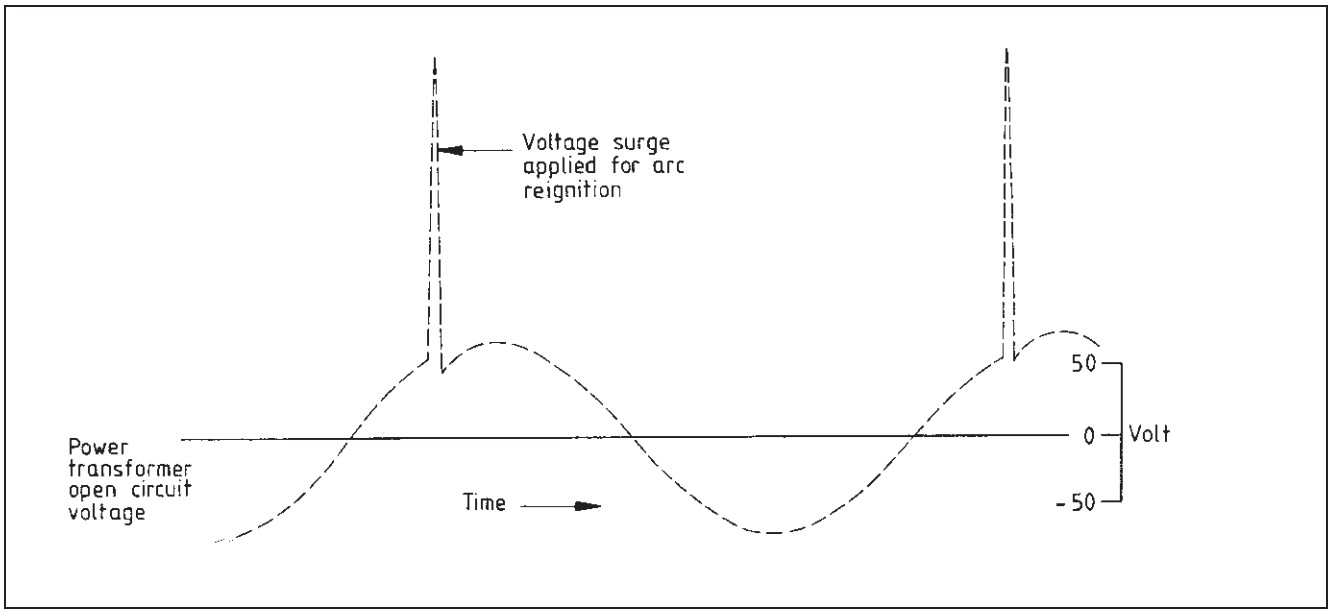
1 Workpiece
2 Arc
3 Weld
4 Torch
5 Contact tip
6 Flux-cored electrode
7 Wire feed rolls
8 Power source

No.	Term	Definition
32 096	**open arc welding**	arc welding in which the arc is visible
32 097	**controlled-arc welding**	arc welding in which the electrode is fed to the arc at a rate controlled by the arc voltage to maintain a constant arc length
32 098	**self-adjusting arc welding**	metal-arc welding in which the 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
32 099	**touch welding** contact welding	metal-arc welding using a covered electrode, the covering of which is kept in contact with the parent metal during welding
32 100	**parallel welding**	arc welding using two electrodes connected in parallel to one power source and feeding the same weld run
32 101	**multi-power welding**	arc welding using two or more power sources, each connected to a separate electrode, which feed the same weld run
32 102	**series arc welding**	arc welding using two electrodes connected in series to one power source and which feed the same weld run

No.	Term	Definition
32 103	**firecracker welding**	metal-arc welding in which a covered electrode is or electrodes are laid on the parent metal; the arc is started between one end of the electrode and the work and travels along the work as the electrode melts
32 104	**CO_2 welding**	metal-arc welding in which a bare wire electrode is used, the arc and molten pool being shielded with carbon dioxide
32 105	**tungsten-arc spot welding**	arc spot welding using a tungsten electrode
32 106	**CO_2 spot welding**	arc spot welding using a consumable electrode in which the arc and molten pool are shielded from the atmosphere by carbon dioxide gas
32 107	**atomic-hydrogen welding**	arc welding in which molecular hydrogen, passing through an arc between two tungsten or other suitable electrodes, is changed to its atomic form and then recombines to supply the heat for welding
32 108	**bare wire elecrode**	solid wire or rod consumable electrode without covering or core
32 109	**sheathed electrode**	covered electrode having an external sheath
32 110	**iron oxide electrode**	covered electrode in which the covering contains a high proportion of iron oxide
32 111	**alloy powder electrode**	covered electrode in which the covering contains powders which, with the core wire, form an alloy when deposited
32 112	**deep penetration electrode**	covered electrode in which the covering aids the production of a penetrating arc to give deeper than normal fusion in the root of a joint
32 113	**hard facing electrode** hard surfacing electrode	metal-arc welding electrode which, by virtue of the composition of the core or the covering or both, will deposit metal that is harder than the parent metal or can be hardened
32 114	**guide tube**	rigid tube that guides a filler wire or electrode but does not convey current
32 115	**crater filler**	device used in automatic and semi-automatic arc welding, or arc spot welding, that gradually reduces the welding current at the end of a weld run or just before the arc is extinguished, thereby preventing the formation of a crater
32 116	**arc energy**	*in arc welding,* amount of heat generated in the welding arc, referenced to a characteristic dimension, which in a linear weld is per unit length of weld (kJ/mm) *NOTE Where the thermal efficiency (31 155) is less than unity, this will be greater than the heat input.*
32 117	**true arc voltage**	voltage between the two ends of an electric arc
32 118	**restriking voltage**	transient voltage that develops between the electrode and the workpiece immediately following arc extinction, causing the arc to restrike
32 119	**spark starting** HF ignition	ignition of an arc by a high voltage high frequency spark applied across the arc gap
32 120	**cyclic reignition voltage**	*In tungsten inert-gas welding*, voltage between the electrode and work required to reignite an a.c. arc at the start of each half cycle

No.	Term	Definition
32 121	**spark reignition** HF reignition	reignition of an a.c. arc, after extinction at zero current, by a high voltage high frequency spark applied across the arc gap
32 122	**surge reignition**	reignition of the arc, after extinction at zero current, by a voltage pulse applied across the arc gap when the electrode is positive, to produce a superimposed restriking voltage (see Figure 74)

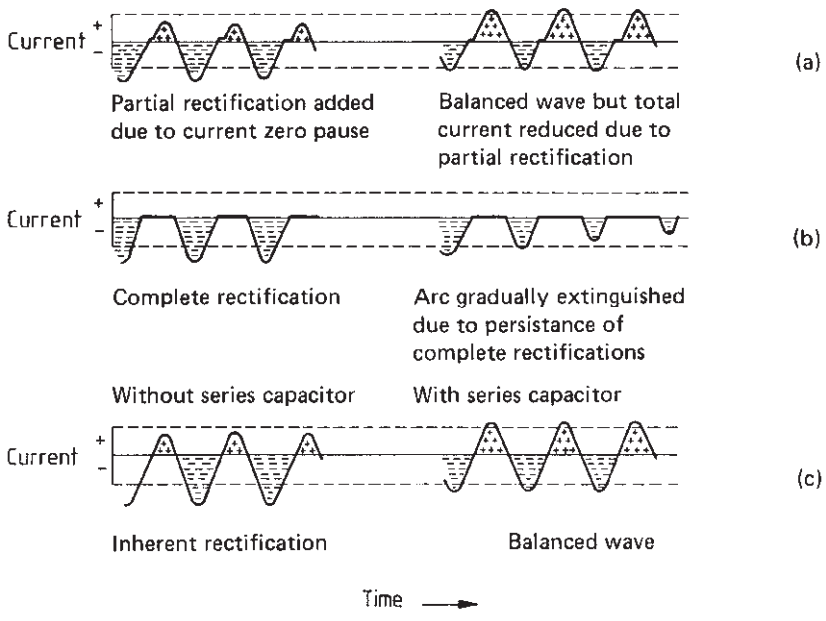
Figure 74 **Surge reignition**



No.	Term	Definition
32 123	**surge injector**	device for maintaining an a.c. arc by surge reignition
32 124	**HF unit** HF ionizer: *deprecated*	high frequency electrical oscillator used to enable an arc to be initiated without contact between the electrode and the workpiece
32 125	**drooping characteristic welding power source**	arc welding power source, the terminal voltage of which drops to a value appreciably below the open circuit voltage after the arc has been struck
32 126	**rising characteristic welding power source**	arc welding power source the terminal voltage of which rises to a value slightly above the open circuit voltage after the arc has been struck
32 127	**motor generator welding power source**	arc welding power source consisting of a generator and an electric motor which are directly coupled, for supplying direct current for welding
32 128	**rectifier welding power source**	arc welding power source consisting of a static converter for supplying direct current for welding from an a.c. supply
32 129	**slope-led welding power source**	arc welding power source, the volt-ampere characteristic of which can be selected from substantially flat to drooping to obtain the desired arc condition *NOTE This should not be confused with term 22 127.*
32 130	**arcing time factor**	ratio of arcing time to the total time the supply is available for the arc

No.	Term	Definition
32 131	**load current**	current flowing for test purposes between the output terminals of an arc welding set (i.e. those to which the electrode and return leads are connected) through a resistance load
32 132	**load voltage**	voltage between the output terminals of an arc welding set when the load current is flowing
32 133	**maximum welding current**	maximum current that can be supplied from a single welding point at a specified load voltage
32 134	**maximum continuous hand-welding current**	maximum current that a single welding point is capable of supplying, without the plant exceeding the specified rise in temperature, when supplying an arc for an operator engaged continuously on manual metal-arc welding
32 135	**typical electrode current**	current at which an electrode may generally be used satisfactorily in a given position
32 136	**electrode current range**	range of current within which an electrode can be used satisfactorily
32 137	**zero current pause**	period of time in a half cycle between arc extinction and reignition during which no current flows
32 138	**partial rectification**	*In tungsten inert-gas welding*, loss of current during part of each half cycle when the electrode is positive; the arc, extinguished as in complete rectification, is ignited later in the same half cycle (see Figure 75)
32 139	**complete rectification**	*In tungsten inert-gas welding*, complete loss of current during each half cycle when the electrode is positive, due to failure of the arc to reignite (see Figure 75)
32 140	**inherent rectification**	*In tungsten inert-gas welding*, asymmetry between the positive and the negative half cycles of current that normally exists even when there is no partial or complete rectification (see Figure 75)

Figure 75 **Types of rectification**



No.	Term	Definition
32 141	**arc fan**	fan-shaped flame associated with the atomic-hydrogen arc
32 142	**TIG torch** argon-arc torch	combined electrode holder and gas nozzle to convey current to the electrode and gas to shield the arc and weld area
32 143	**MIG gun** CO_2 gun	combined electrode contact tube and nozzle to convey current to a wire electrode and gas to shield the arc and weld area
32 144	**atomic-hydrogen torch**	electrode holder carrying the electrodes and incorporating a means of supplying hydrogen to the arc in atomic-hydrogen welding
32 145	**hydrogen valve**	electrically operated on/off valve used in atomic-hydrogen welding to allow hydrogen to flow only when an arc has been struck
32 146	**electrode positive**	arc welding using direct current in which the electrode is connected to the positive pole of the supply *NOTE This has sometimes been known in British practice as "straight polarity" and in American practice as "reversed polarity". For this reason both these terms are deprecated.*
32 147	**electrode negative**	arc welding using direct current in which the electrode is connected to the negative pole of the supply *NOTE This has sometimes been known in British practice as "reversed polarity" and in American practice as "straight polarity". For this reason both these terms are deprecated.*
32 148	**melt**	flux used in submerged-arc welding
32 149	**fused melt**	glass-like material formed from the powdered flux during submerged-arc welding
32 150	**burden**	layer of melt and fused melt above the welding zone in submerged-arc welding
32 151	**electrode efficiency** electrode recovery; electrode yield	ratio of mass of all-weld metal deposited in the groove or on the workpiece to the mass of filler metal consumed, or to the core wire consumed in metal-arc welding with covered electrode, expressed as a percentage
32 152	**stub-in**	freezing of the electrode into the weld
32 153	**burn-back**	fusing of the electrode wire to the current contact tube by sudden lengthening of the arc in any form of automatic or semi-automatic metal-arc welding using a bare wire electrode
32 154	**spatter loss**	proportion of a consumable electrode or electrode core wire that is lost as spatter
32 155	**striking plate**	piece of material, kept close to the workpiece, on which an arc is struck before the electrode is transferred to the work
32 156	**automatic stud welding equipment**	stud welding equipment in which the complete sequence of operations is automatically controlled after being initiated
32 157	**stud welding tool**	appliance for holding, positioning and controlling the movement of the stud during stud welding, and for conveying pressure and current to it during the welding cycle
32 158	**spatter shield**	device on a stud welding tool to restrict the spread of weld spatter
32 159	**stud welding controller**	part of a stud welding equipment used to control the sequence of operations in the making of a stud weld

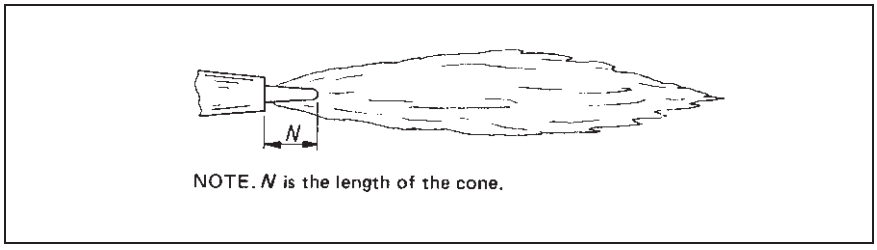
No.	Term	Definition
32 160	**stud welding gun**	stud welding tool intended to be held in the hand
32 161	**lift**	distance by which the stud is retracted from the parent metal in order to initiate the arc in stud welding
32 162	**arc damper** arc blow compensator	device in a stud welding tool for controlling the arc blow in the welding arc
32 163	**granular flux filled stud**	stud, hollow at the welding end, containing granular flux held in place by a metal cap
32 164	**metallized fluxed stud**	stud that is fluxed on the welding end by a metallization process
32 165	**slug loaded stud**	stud to the welding end of which is attached a solid slug or pellet of flux
32 166	**fillet** collar	ring of weld metal formed round the base of a welded stud
32 167	**ferrule**	sleeve or bush of refractory material surrounding the base of a stud during arc stud welding to protect and contain the molten metal and, where required, to shape the weld fillet
32 168	**fluxed ferrule**	sleeve, bush or cap containing material for fluxing purposes for attachment to the end of a stud
32 169	**MIG pulsed-arc welding**	metal inert-gas welding in which a background direct current arc is maintained to supply heat to the workpiece and electrode wire and a regular pulsed current of the same polarity (usually electrode positive) and of a higher peak value is applied to control metal transfer
32 170	**TIG pulsed-arc welding**	tungsten inert-gas welding in which a background direct current is maintained to preserve an ionized path for the arc and a regular pulsed current of the same polarity (usually electrode negative) is applied to control heat input to the workpiece
32 171	**self-regulating arc-welding transformer**	arc-welding transformer in which the voltage drop increases substantially with the secondary load current
32 172	**self-regulating d.c. welding generator**	d.c. welding generator in which the voltage drop increases substantially with the load current
32 173	**braided electrode**	covered electrode with the covering reinforced by a process of braiding
32 174	**dipped electrode**	covered electrode produced by single or multiple dipping of the core wire into a paste of flux
32 175	**extruded electrode**	covered electrode produced by extruding the flux on to the core wire
32 177	**dense slag** solid slag	slag of limited porosity that may exert mechanical pressure to produce a smooth weld face
32 178	**porous slag**	slag that has a honeycomb structure
32 179	**friable slag**	slag that crumbles easily to aid removal
32 180	**fluid slag**	slag with slow freezing properties that flows freely during deposition of an electrode
32 181	**viscous slag**	slag with quick freezing properties that does not flow freely during deposition of an electrode

No.	Term	Definition
32 182	**non-shielded welding**	metal-arc welding using a cored electrode in which materials for controlling the quality of the weld metal are contained in the wire or core without the use of an external shielding
32 183	**stick electrode**	straight covered electrode for metal-arc welding having one end bare for insertion in an electrode holder
32 184	**continuous covered electrode**	covered electrode supplied in coils for automatic welding, having a core wire surrounded by two or more helically wound wires which reinforce the covering and conduct current to the core wire
32 185	**synergic pulsed MIG welding**	form of pulsed MIG welding using electronic control logic to determine the value of the pulse parameters and pulse frequency, according to the selected value of wire feed speed
32 186	**A-TIG**	TIG welding using an activating flux
32 187	**tandem arc welding**	arc welding using two power sources, each connected to one electrode wire and fed simultaneously into the same weld pod
32 188	**twin wire welding**	arc welding using two filler wires connected to one power source and delivered through a single contact tube

Subsection 33. Terms relating only to gas welding

No.	Term	Definition
33 001	**gas welding**	fusion welding, with or without filler metal, in which the heat for welding is produced by the combustion of a fuel gas or gases with an admixture of oxygen
33 002	**oxy-acetylene welding**	gas welding in which the fuel gas is acetylene *NOTE Other fuel gases are also used with oxygen (i.e. butane, hydrogen and propane); in such cases appropriate alterations to the term and the definition are necessary.*
33 003	**neutral flame**[11)]	flame in which the first stage of combustion is complete, with no excess of oxygen in the cone visible at the nozzle orifice (see Figure 76)
33 004	**reducing flame**	flame in which the portion used has a de-oxidizing effect
33 005	**carburizing flame** [11)]	flame in which there is an excess of a carbonaceous fuel gas, resulting in a carbon-rich zone extending around and beyond the cone (see Figure 77 and Figure 78)
33 006	**oxidizing flame**	flame in which there is an excess of oxygen, resulting in an oxygen-rich zone just beyond the cone (see Figure 79)

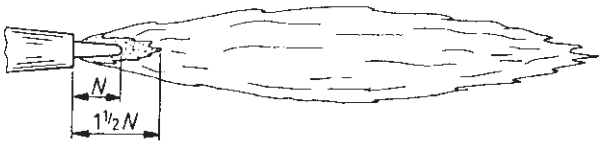
Figure 76 **Neutral oxy-acetylene flame**



NOTE. *N* is the length of the cone.

[11)] Neutral and carburizing flames are reducing in nature.

Figure 77 **Carburizing oxy-acetylene flame**



NOTE. *N* is the length of the cone. 1½*N* is the length of the feather.

Figure 78 **Carburizing oxy-acetylene flame for a hard surfacing application**

NOTE. *N* is the length of the cone. 2½*N* is the length of the feather.

Figure 79 **Oxidizing oxy-acetylene flame**

NOTE. The flame is set to neutral and the fuel gas is then turned down to achieve a cone length less than *N*.

No.	Term	Definition
33 007	**leftward welding** forward welding	gas welding technique where the filler rod is moved ahead of the blowpipe in relation to the welding direction (see Figure 80)
33 008	**rightward welding** backward welding	gas welding technique where the filler rod is moved behind the blowpipe in relation to the welding direction (see Figure 81)

Figure 80 **Leftward welding**

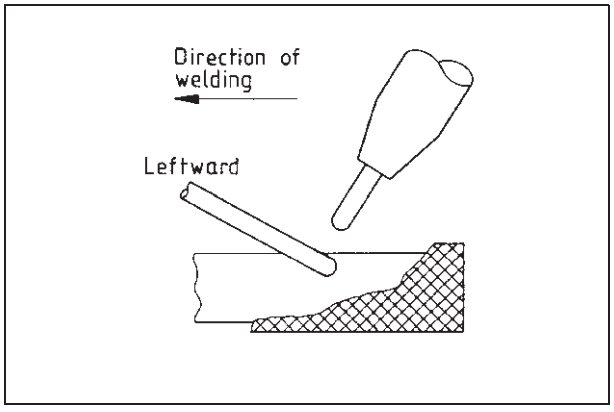
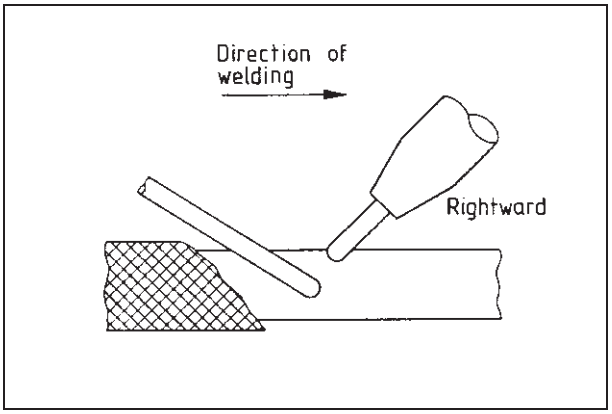


Figure 81 **Rightward welding**

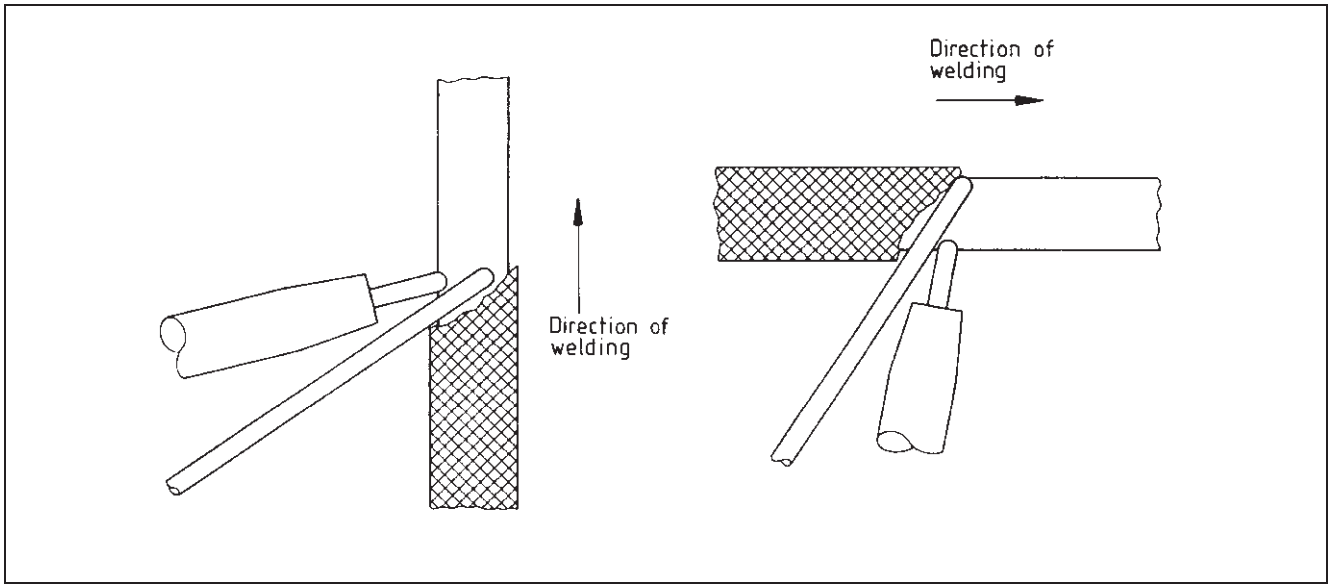


No.	Term	Definition
33 010	**welding blowpipe**	welding torch in which a fuel gas is mixed with oxygen to produce a flame that can be controlled to be oxidizing, neutral or reducing
33 014	**automatic quick-acting shut-off device**	self-acting device which closes quickly e.g. when triggered by an acetylene explosion in the high pressure manifold pipework
33 015	**backfire**	retrogression of the flame into the blowpipe neck or body with rapid self-extinction
33 016	**backflow**	flowing back of the gas at the higher pressure into the hose of the gas at the lower pressure; this can be caused by the nozzle exit becoming blocked or restricted
33 017	**blowing off the flame**	detachment of the flame from the blowpipe nozzle; this may cause the flame to be extinguished
33 018	**blowpipe with a single flow rate**	blowpipe, which due to design gives a single nominal gas flow rate that can only be varied within narrow limits
33 019	**blowpipe with multiple flow rates**	blowpipe giving a range of flow rates corresponding to a series of nozzles
33 020	**blowpipe with nozzle mixing**	blowpipe with a nozzle that contains a mixer or an injector-mixer
33 021	**blowpipe with preliminary mixer**	cutting blowpipe in which the mixture of heating oxygen and fuel gas is ensured by the injectormixer located before the cutting nozzle
33 022	**burst pressure**	pressure which causes failure of, and consequential fluid loss through the component envelope
33 024	**cylinder bundles**	cylinder arrangements which are connected together for collective filling and emptying
33 025	**excess flow cut-off valve**	device which stops the gas flow in the event of flow exceeding a predetermined value
33 029	**high pressure blowpipe**	blowpipe in which the pressure of both the fuel gas and the oxygen/compressed air, measured immediately before the point of mixing, is higher than the pressure of the gas mixture, measured between the point of mixing and welding nozzle
33 031	**hose assembly**	assembly consisting of a hose tail inserted into the end of a hose and secured by a suitable hose clamp *NOTE A typical hose assembly consists of: hose tail, hose, hose clamp.*
33 032	**hose clamp**	device for fastening the hose on the hose tail
33 034	**hose tail**	end of a coupling device to be inserted into a hose
33 035	**injector-mixer**	device in which gas leaving an injector entrains and mixes with another gas which is at a lower pressure
33 036	**low pressure blowpipe**	blowpipe in which the fuel gas pressure, measured immediately before the mixing chamber, is lower than the pressure of the gas mixture, measured between the mixing chamber and welding nozzle
33 042	**manual quick acting shut-off valve**	manually activated device to quickly stop the gas flow

No.	Term	Definition
33 044	**mixer without injector action**	mixing systems in which the fuel gas and the oxidizing gas are discharged; the pressure in this channel is higher than the atmospheric pressure
33 046	**multifunctional safety device**	device which incorporates two or more of the safety functions
33 048	**non-return valve**	valve that prevents the passage of gas in the opposite direction to the normal flow
33 050	**pressure-sensitive cut-off valve**	device which stops the gas flow in the event of a back-pressure wave from the downstream side
33 051	**pressure relief valve**	device which automatically vents gas when the pressure exceeds some predetermined value and seals again when the pressure returns to within specified limits of that value
33 052	**proof pressure**	maximum pressure to which the equipment might be subjected in service
33 054	**quick-action coupling with shut-off valve**	device enabling a rapid coupling or uncoupling under pressure of two elements and/or hoses, which automatically releases the gas flow during connection and prevents the escape of gas when disconnected
33 060	**sustained backfire**	retrogression of the flame into the blowpipe neck or body, the flame remaining alight *NOTE This manifests itself either as "popping" or "squealing" with a small pointed flame issuing from the nozzle orifice, or as a rapid series of minor explosions inside an overheated nozzle.*
33 061	**temperature sensitive cut-off device**	device which stops the gas flow when a predetermined temperature is exceeded
33 062	**assembled hose**	length of hose fitted at each end with a hose assembly
33 063	**blowpipe with a fixed mixer**	blowpipe with multiple flow rates which are varied by adjusting the feed pressures
33 065	**blowpipe with a variable injector**	blowpipe with multiple flow rates which are varied by means of a device for adjustment of the injector cross-section
33 066	**blowpipe with an interchangeable injector**	blowpipe with multiple gas flow rates which are varied by changing the injector; the latter often forms a single component with the outlet nozzle
33 067	**blowpipe with multiple flow rates adjusted by means of gas control valves**	blowpipe with multiple flow which is varied by means of the adjustment valves
33 068	**closing pressure**	stablilized outlet pressure (stabilization after flow ceases) one minute after stopping the standard discharge
33 069	**discharge of the relief valve**	minimum discharge (rate of unit volume) of the relief valve
33 070	**external gas leakage**	undesired escape of gas from a product to the atmosphere
33 071	**internal gas leakage**	undesired escape of gas between chambers with different pressures inside a product
33 072	**manifold systems**	systems in which two or more single cylinders or bundles are coupled on the high pressure side for collective gas withdrawal
33 073	**maximum operating pressure**	maximum pressure to which the equipment might be subjected in service

No.	Term	Definition
33 074	**maximum permissible external leakage rates**	total leakage rates for a complete product including inlet connection
33 076	**nominal outlet pressure**	downstream pressure corresponding to a defined flow (standard discharge defined either by its class of equipment or in the technical leaflets)
33 077	**nominal inlet pressure**	inlet pressure defined by the manufacturer and for which the equipment is intended to work
33 078	**routine manufacturing test**	revealing test where all manufactured products are checked by the manufacturer in order to verify and maintain the product quality level
33 079	**safety device**	device for welding equipment which averts risk in case of misuse or malfunction of the downstream gas welding equipment
33 080	**spontaneous ignition temperature**	in the absence of any energy source, temperature at which spontaneous ignition of a sample occurs in oxygen
33 081	**standard discharge**	discharge (rate of unit volume) specified by the relevant standard or by the manufacturer under specified conditions
33 082	**type test**	tests of an equipment to prove conformance to the specific standard
33 083	**upstream pressure for type testing**	pressure equal to twice the nominal outlet pressure plus 1 bar
33 084	**all-position rightward welding**	welding technique in which the flame and filler rod are directed towards the unwelded part of the joint, the welding rod being directed in between the flame and the weld (see Figure 82)
33 085	**surface fusion welding** semi-fusion welding: *deprecated*	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 hard facing, building-up and the like.*

Figure 82 **All-position rightward welding**



Subsection 34. Terms relating only to electron beam welding

No.	Term	Definition
34 001	**electron beam welding** EB welding	fusion welding in which the heat for welding is generated by the impact of a focused beam of electrons
34 002	**electron gun**	device for producing electrons and the means by which they are accelerated and focused on to the workpiece
34 003	**low voltage electron gun**	electron gun with an accelerating voltage up to and including 40 kV
34 004	**medium voltage electron gun**	electron gun with an accelerating voltage greater than 40 kV up to and including 60 kV
34 005	**high voltage electron gun**	electron gun with an accelerating voltage greater than 60 kV
34 006	**beam current**	current flowing between the cathode and the anode of an electron gun, expressed in milliamperes
34 007	**beam power**	product of accelerating voltage and beam current, expressed in kilowatts
34 008	**beam power density** specific beam power	value expressed in kilowatts per unit area, obtained by dividing the beam power by the cross-sectional area of the electron beam at a specified position
34 009	**working distance**	distance between a reference point, usually the lower member of the electron gun, and the point at which the beam impinges on the workpiece
34 010	**beam pulsing**	production of a non-continuous electron beam
34 011	**accelerating voltage**	voltage between the cathode and the anode that accelerates the electrons
34 012	**beam current pulsing**	*in electron beam welding*, intentional periodic variation of the beam current
34 013	**beam deflection**	*in electron beam welding*, electromagnetic deflection of the beam from the gun axis
34 014	**beam oscillation**	*in electron beam welding*, intentional periodic deflection of the beam, achieved by electromagnetic forces
34 015	**spot position**	*in electron beam welding*, position of the electron beam when it impinges on the workpiece surface with respect to a system of co-ordinates perpendicular to the axis of the beam
34 016	**electron beam welding machine**	apparatus for providing and controlling the energy and including if necessary the associated work manipulating system for making an electron beam weld
34 017	**directly heated gun**	electron gun in which the cathode is heated directly by the filament current (see Figure 83 and Figure 84)
34 018	**diode gun**	electron gun, directly heated, with two electrodes wherein the beam current is adjusted by varying the cathode temperature, accelerating voltage or electrode spacing or any combination of these variables (see Figure 83)
34 019	**triode gun**	electrode gun, directly heated, with three electrodes wherein the beam current is usually controlled by a grid electrode but is dependent on the cathode temperature, the accelerating voltage and perveance (see Figure 84)

No.	Term	Definition
34 020	**back-bombarded gun**	electron gun in which the cathode is heated by bombardment with electrons from a separated primary gun (see Figure 85)

Figure 83 **Diagrammatic representation of a diode gun**

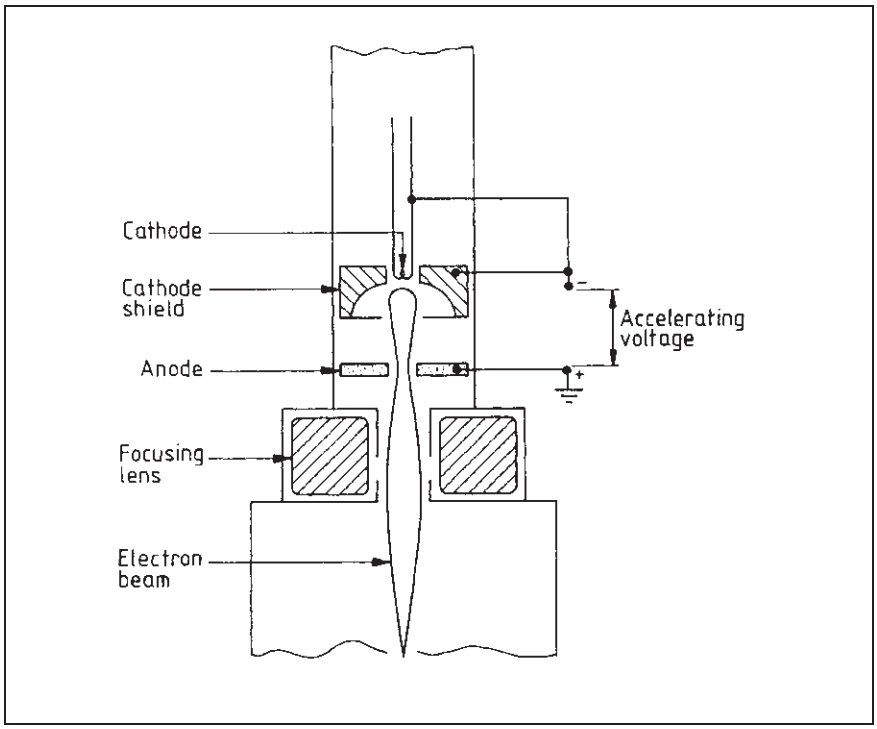


Figure 84 **Diagrammatic representation of a triode gun**

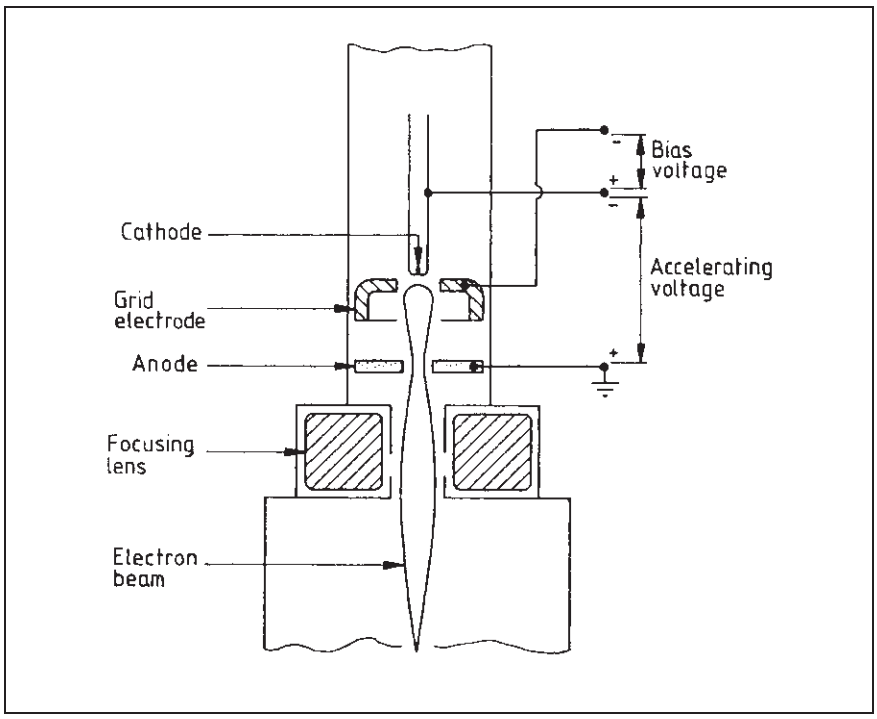
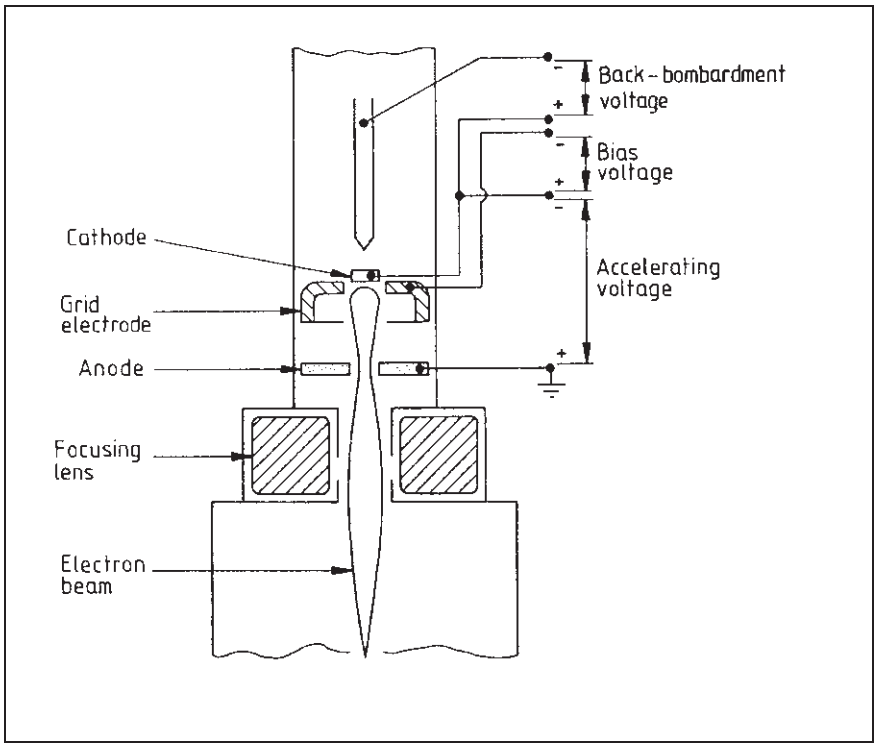


Figure 85 **Diagrammatic representation of a back-bombarded gun**



No.	Term	Definition
34 021	**cathode** filament	source from which electrons are emitted
34 022	**filament current** heater current	current that heats the cathode to a temperature to produce the required electron emission
34 023	**grid electrode** bias electrode	electrode that controls the magnitude of the beam current and which is negative in respect to the cathode of the electron gun
34 024	**cathode shield** field electrode	electrode that surrounds the cathode and is at the same potential
34 025	**perveance**	geometric characteristic, *G*, of an electron gun that relates the current and accelerating voltage according to the formula: $G = \frac{I}{V^{3/2}}$ where: *I* is the beam current (in amperes); *V* is the accelerating voltage (in volts)
34 026	**bias voltage**	voltage applied between the cathode and the grid electrode to control the magnitude of beam current independently of accelerating voltage and perveance changes
34 027	**beam current control**	means of adjusting the beam current by controlling the bias voltage or the cathode temperatures or by changing the perveance value
34 028	**beam deflector** deflection coils	electromagnetic means of deflecting the electron beam

No.	Term	Definition
34 029	**focusing lens**	magnetic coils or electrostatic devices which provide the field for focusing the electron beam
34 030	**focus control**	device to control the magnitude of the current or voltage in the focusing lens
34 031	**optical viewing system**	means for viewing the point of beam impingement by looking down the path of the electron beam
34 032	**full vacuum system** hard vacuum system	electron beam welding machine, the work chamber and electron gun of which operate at a vacuum of better than 5×10^{-4} mbar (5×10^{-2} Pa)
34 033	**partial vacuum system** soft vacuum system	electron beam welding machine with a separately pumped electron gun, the work chamber of which operates at a vacuum in the range 5×10^{-3} mbar to 5×10^{-1} mbar (5×10^{-1} Pa to 50 Pa)
34 034	**out of vacuum system** non-vacuum system	electron beam welding machine with a separately pumped electron gun in which the electron beam is transmitted via a specially designed orifice to the workpiece in an environment at atmospheric pressure
34 035	**separately pumped electron gun**	electron gun pumped to a vacuum better than 1×10^{-4} mbar (1×10^{-2} Pa) irrespective of the pressure surrounding the workpiece
34 036	**beam spinning**	use of magnetic deflection of the beam to cause it to describe a circular path in order to redistribute the energy profile, usually the frequency of rotation being in the range 50 Hz to 5 000 Hz
34 037	**focusing lens current**	*In electron beam welding*, current passing through the focusing lens coil

Subsection 35. Terms relating only to light radiation welding

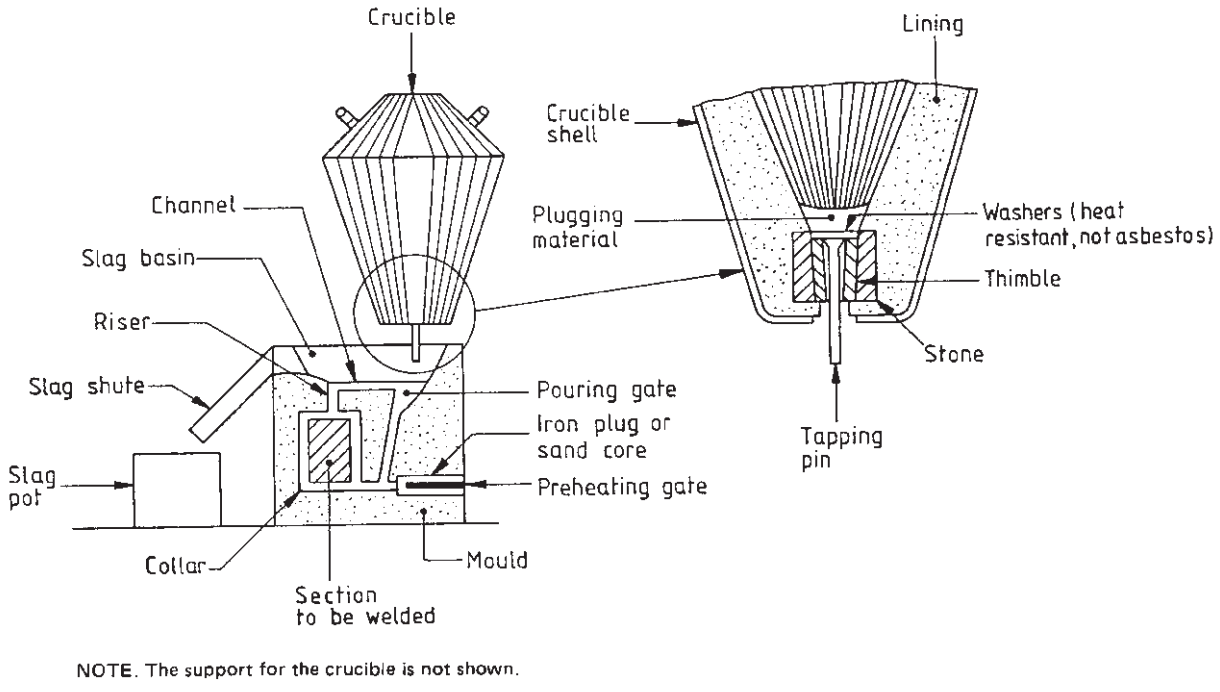
No.	Term	Definition
35 001	**light radiation welding**	fusion welding in which the heat for fusion is produced by an optically focused beam of radiation, welding being carried out in a vacuum or under the protection of a shielding gas or under normal atmospheric conditions, generally without the addition of a filler metal
35 002	**laser welding**	fusion welding in which the heat for fusion is produced by a coherent beam of monochromatic radiation from a laser
35 003	**laser**	equipment for producing a coherent beam of monochromatic radiation *NOTE The word laser is derived from Light Amplification by Stimulated Emission of Radiation.*
35 004	**solid state laser**	laser in which the beam is generated by a solid medium, e.g. yttrium aluminium garnet
35 005	**gas laser**	laser in which the beam is generated by an activated gas, e.g. CO_2
35 006	**focal length**	distance between the optical centre of the focusing lens and the position of the focal spot

No.	Term	Definition
35 007	**focal spot**	part of the beam beyond the lens system where the beam comes to a minimum cross-sectional area
35 009	**arc image welding**	light radiation welding in which the heat for fusion is produced by a non-coherent beam of radiation of a particular frequency band, the source of light being an arc

Subsection 36. Terms relating only to aluminothermic welding

No.	Term	Definition
36 001	**aluminothermic welding** thermit welding	flow welding whereby the welding heat is obtained from reacting a mixture of metal oxides with finely ground aluminium powder whose ignition produces an exothermic reaction in which the molten metal produced is the filler material
36 002	**thermit mixture**	mixture of metallic oxides and finely divided aluminium, whose ignition produces an exothermic reaction, reducing the mixture to molten metal and slag accompanied by intense heat *NOTE The composition of the thermit mixture is varied to suit the type of steel or cast iron to be welded.*
36 003	**ignition powder**	readily ignitable mixture, usually of powdered aluminium and oxidizing material, used for initiating the reaction in aluminothermic welding
36 004	**igniter**	device used in place of ignition powder
36 005	**thermit crucible**	vessel in which the thermit reaction takes place, with a hole in the bottom through which the molten metal passes (see Figure 86)
36 006	**stone**	ring of refractory material, usually pressed magnesite, built into the bottom of a thermit crucible for the reception of a thimble (see Figure 86)
36 007	**thimble**	renewable ring of refractory material, usually magnesite, inserted in a stone to act as a nozzle when the crucible is tapped (see Figure 86)
36 008	**tapping pin**	metal plug closing the hole in a thimble (see Figure 86)
36 009	**plugging material**	refractory material placed on top of a tapping pin to prevent the pin from melting (see Figure 86)
36 010	**wax pattern**	pattern formed of wax that is moulded around the parts to be welded, and which becomes the foundation of a mould and is then melted out prior to preheating
36 011	**mould**	receptable that may be either formed round the parts to be welded or preformed and placed round them to receive the molten metal from the crucible (see Figure 86) *NOTE The mould material is usually a mixture of natural or synthetic high-silica sand and plastic clay.*
36 012	**preheating gate**	opening in a mould to facilitate preheating of parts to be joined by aluminothermic welding (see Figure 86)
36 013	**pouring gate**	opening in a mould into which the molten metal is poured from the crucible (see Figure 86)

Figure 86 **Basic equipment for aluminothermic welding**



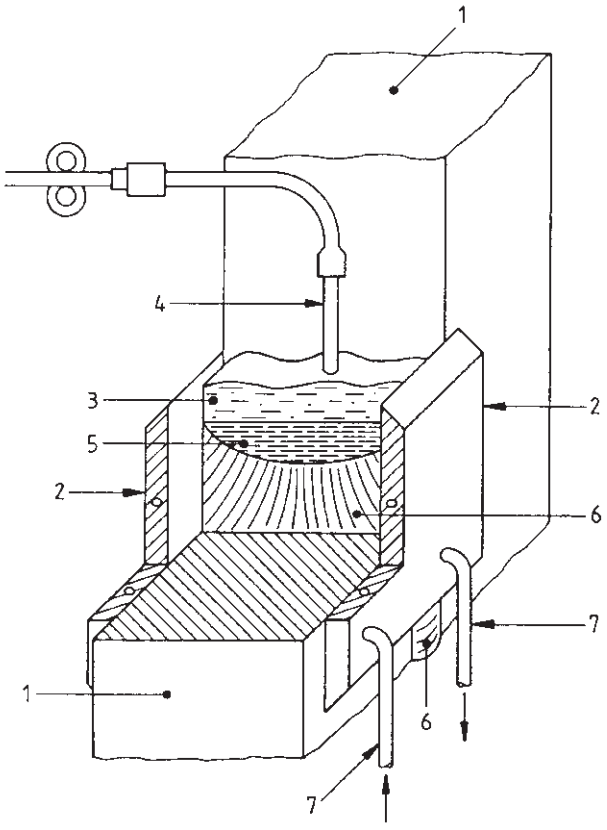
NOTE. The support for the crucible is not shown.

No.	Term	Definition
36 014	**riser**	reservoir of molten metal above the highest point of an aluminothermic weld to compensate for shrinkage and to collect scale and other impurities arising during welding (see Figure 86)
36 015	**slag basin**	depression in the top of a mould to contain a portion of the slag (see Figure 86)
36 016	**slag pot**	vessel to receive slag overflowing from the slag basin (see Figure 86)
36 017	**slag shute**	channel to conduct slag from the slag basin into the slag pot (see Figure 86)
36 018	**collar**	weld metal projecting around the periphery of a weld made by aluminothermic welding (see Figure 86)

Subsection 37. Terms relating only to electro-slag welding

No.	Term	Definition
37 001	**electro-slag welding**	fusion welding utilizing the combined effects of current and electrical resistance in a consumable electrode(s) and a conducting bath of molten slag, through which the electrode(s) passes into a molten pool, both the pool and slag bath being retained in the joint by cooled shoes which move progressively upwards; after an initial arcing period, the end of the electrode is covered by the rising slag, and melting then continues until the joint is completed (see Figure 87)
37 002	**consumable wire guide** consumable nozzle	wire guide, which may be coated or uncoated, made of material similar in composition to that being welded and progressively consumed to form part of the weld metal

Figure 87 **Electro-slag welding**



Key
1 Plates to be welded
2 Shoes
3 Molten slag
4 Electrode
5 Molten metal
6 Finished weld

No.	Term	Definition
37 003	**cooled shoe**	metal shoe, having passages for the cooling medium, that supports the molten pool and which is moved upwards as welding progresses
37 004	**starting block**	piece of metal that is placed at the bottom of the joint preparation and used to strike the starting arc and which supports the initial molten pool
37 005	**electro-slag welding flux**	flux that, when molten, forms a slag pool of controlled electrical conductivity which melts the filler metal passing through and protects the molten weld pool

Section 4. Terms relating to braze welding and brazing

Subsection 40. Terms relating only to braze welding

No.	Term	Definition
40 001	**braze welding**	joining of metals using a technique similar to fusion welding and a filler metal with a lower melting point than the parent metal, but neither using capillary action as in brazing nor intentionally melting the parent metal
40 002	**bronze welding**	form of braze welding in which copper-rich filler metal is used *NOTE The term "bronze" is not used here in the ordinary metallurgical sense.*
40 003	**gas fluxing**	method of supplying a flux in gas form to the joint during braze welding *NOTE The flux, originally liquid, is generally entrained by the fuel gas from a dispenser and passes through the flame to the joint.*
40 004	**bronze filler metal** bronze welding rod	filler metal used for bronze welding, consisting basically of copper and zinc, but can also contain nickel, manganese or other metals *NOTE The term "bronze" is not used here in the ordinary metallurgical sense.*
40 005	**bell butt joint**	joint between two pipes of similar diameter, in which one pipe end is swaged out to receive the end of the other pipe (see Figure 88)
40 006	**diminishing bell butt joint**	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 Figure 89)

Figure 88 **Bell butt joint**

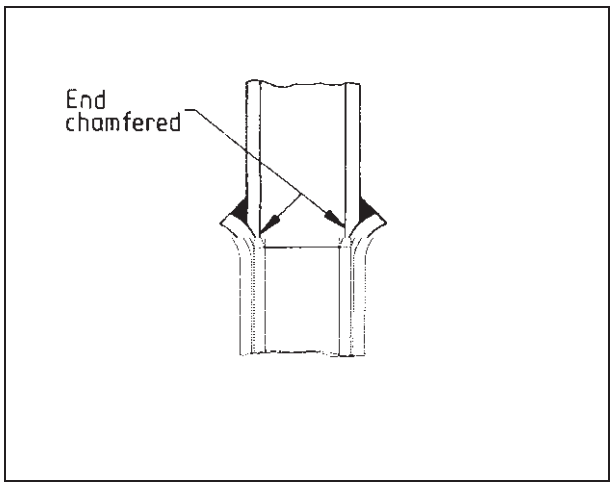
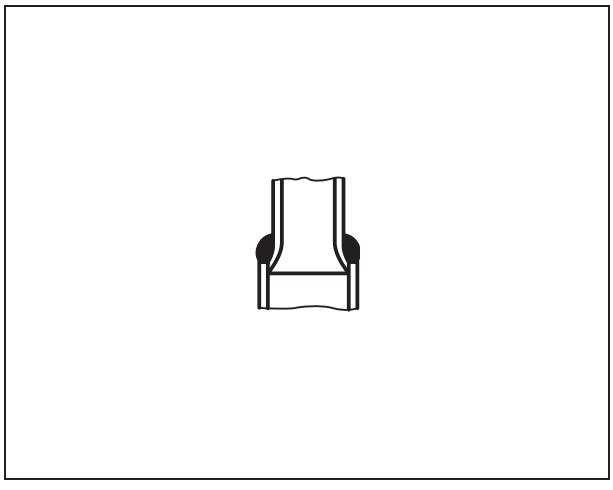


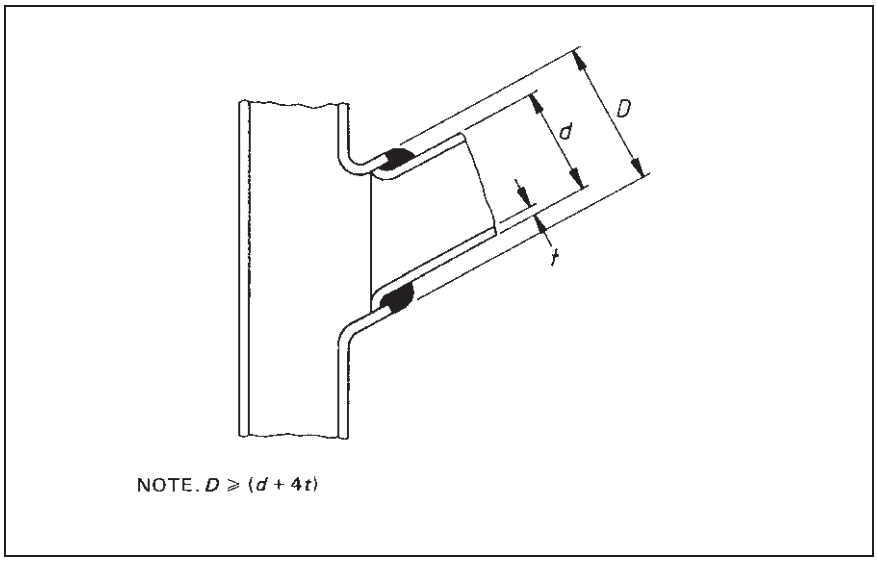
Figure 89 **Diminishing bell butt joint**



No.	Term	Definition
40 007	**branch T saddle joint**	joint between a branch pipe and a main pipe set at 90° to each other, the end of the branch pipe being shaped to fit snugly against the main pipe

No.	Term	Definition
40 008	**short bell branch joint**	branch joint in which the metal round a hole in a main pipe is swaged out to receive the swaged end of a branch pipe (see Figure 90)
40 009	**air-acetylene blowpipe: bunsen type**	blowpipe incorporating an open injector-mixer in the blowpipe shank
40 010	**air-acetylene blowpipe: high temperature type**	blowpipe incorporating an open injector-mixer in the nozzle
40 011	**bond weld**	weld made between a stranded flexible copper conductor and a steel rail to ensure electrical conductivity *NOTE Bonds are installed at rail joints, a weld being made at one end of the bond to one rail and at the other end of the bond to the other rail.*

Figure 90 **Short bell branch joint**



Subsection 41. Terms relating only to brazing

No.	Term	Definition
41 001	**brazing**	process of joining generally applied to metals in which, during or after heating, molten filler metal is drawn into or retained in the space between closely adjacent surfaces of the parts to be joined by capillary attraction *NOTE In general the melting point of the filler metal is above 450 °C, but always below the melting temperature of the parent material.*
41 002	**resistance brazing**	brazing in which the filler metal is usually preplaced and heat is produced 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, generally through carbon electrodes in contact with the parts to be joined *NOTE Most of the heat required for brazing is generated externally within the electrode material and is transmitted to the joint by thermal conduction.*

No.	Term	Definition
41 003	**dip brazing**	brazing in which a workpiece is partly or totally immersed in a bath of molten brazing alloy which is covered by a layer of molten flux
41 004	**flame brazing** torch brazing: *deprecated*	brazing in which heat is obtained from a gas flame from a blowpipe
41 005	**furnace brazing**	brazing in which the workpiece complete with preplaced filler metal is raised to brazing temperature in a furnace which may contain a protective atmosphere
41 006	**induction brazing**	brazing in which heat is obtained by inducing high-frequency electric current within the material in the neighbourhood of the joint *NOTE A protective atmosphere may be used.*
41 007	**salt bath brazing**	brazing in which heat is obtained by immersing the workpiece complete with preplaced filler metal in a bath of molten salt of suitable melting point *NOTE The salt used can act as a flux.*
41 008	**flux-dip brazing**	salt bath brazing in which the salt is a flux
41 009	**brazing alloy**	filler metal used in brazing
41 010	**spelter**	brazing alloy consisting nominally of 50% copper and 50% zinc *NOTE The term "spelter" is not used here in the ordinary metallurgical sense.*
41 011	**stopping-off agent**	inert paint-like compound, usually based on a refractory oxide, applied adjacent to the joint to control the undesirable spread of molten brazing alloy and prevent it from adhering to adjacent surfaces
41 012	**vacuum brazing**	brazing in which the workpiece, complete with preplaced filler metal, is raised to brazing temperature in a vacuum
41 013	**braze metal**	all the metal taken into the molten state, i.e. filler metal plus dissolved parent metal, during brazing
41 014	**post-braze diffusion treatment**	heat treatment where diffusion, additional to that inherent in the normal brazing process, is made to take place between the braze metal and the parts to be joined, either to improve the strength of the joint or to raise the remelt temperature of the joint *NOTE This can be carried out either as an extension of the brazing cycle or as a separate treatment.*
41 015	**controlled atmosphere brazing**	brazing in which the workpiece, complete with preplaced filler metal, is raised to brazing temperature in a chamber containing a controlled mixture of gases

Section 5. Terms relating to testing

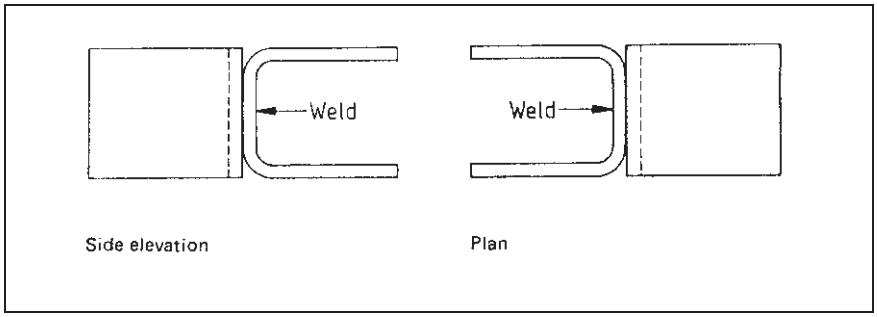
NOTE In terms relating to testing "test piece" and "test specimen" may be used interchangeably, the choice being made according to the custom prevailing in the particular area of industry involved.

50 001	**test piece;** **test specimen** test coupon: *deprecated*	portion detached from a welded component or a welded joint and prepared as required for testing
50 002	**test specimen**	part or portion cut from the test piece in order to perform a specified destructive test
50 003	**all-weld test piece** **all-weld test specimen**	test specimen that is composed only of deposited metal over the portion to be tested
50 004	**transverse bend specimen**	test specimen for a bend test that is transversely bisected by the portion of the weld included in it
50 005	**longitudinal bend specimen**	test specimen for a bend test that is longitudinally bisected by the portion of the weld included in it
50 006	**face bend test**	bend test in which one side of the weld specimen, as described in a) to c), is in tension: a) the side opposite that containing the root or opposite that to which the root is nearer; b) either weld face when the root is central; c) the outer side of a pipe or tube in welds made with pressure
50 008	**root bend test**	reverse bend test in which the root of the weld is on the tension side
50 009	**side bend test**	bend test in which the face of a transverse section of the weld is in tension
50 010	**cracking test**	test to determine the susceptibility to cracking of the weld metal or parent metal
50 011	**hot cracking test** solidification cracking test	test to determine the tendency of a welded joint to develop hot cracks
50 012	**peel test** slug test; plug test	destructive test in which a resistance welded lap joint is tested by applying a peel force which results in stresses mainly in the thickness direction of the weld
50 014	**root bend specimen of butt weld**	test specimen used in a root bend test for a butt weld
50 015	**side bend specimen of cladding without a butt weld**	test specimen used in a side bend test for cladding without a butt weld
50 016	**side bend test specimen of butt weld**	test specimen used in a side bend test for a butt weld
50 020	**testing level**	degree of thoroughness and selection of parameter settings with which an NDT method is applied
50 021	**testing organization**	internal or external organization carrying out the destructive or non-destructive testing
50 023	**face bend test specimen of butt weld**	test specimen used in a face bend test for a butt weld
50 024	**face bend test specimen of cladding without a butt weld**	test specimen used in a face bend test for cladding without a butt weld

No.	Term	Definition
50 025	**side bend test specimen of cladding with a butt weld**	test specimen used in a side bend test for cladding with a butt weld
50 026	**face bend test specimen of cladding with a butt weld**	test specimen used in a face bend test for cladding with a butt weld
50 027	**macroscopic examination**	examination of a test specimen by the naked eye, or under low magnification, with or without etching
50 028	**microscopic examination**	examination of a test specimen by microscope with a magnification normally within 50 to 500 times, with or without etching
50 029	**destructive testing**	testing to detect internal or external imperfections, or assess mechanical or metallurgical properties by mechanical means, which generally result in the destruction of the material
50 030	**non-destructive testing**	act of determining the suitability of some material or component for its intended purpose using techniques that do not affect its serviceability
50 031	**linear indication**	*In non-destructive testing*, indication having a length greater than three times its width
50 032	**non-linear indication**	*In non-destructive testing*, indication having a length less than or equal to three times its width
50 033	**object-to-film distance**	*In radiography*, distance between the radiation side of the test object and the film surface, measured along the central axis of the radiation beam
50 034	**penetrated thickness**	*In radiography*, thickness of material penetrated by the radiation beam
50 035	**projected area**	area where imperfections distributed along the volume of the weld under consideration are imaged two-dimensionally
50 036	**recording level**	*In non-destructive testing*, evaluation level from which an indication is recorded
50 037	**source size**	*In radiography*, size of the radiation source
50 038	**source-to-film distance**	*In radiography*, distance between the radiation source and the film, measured in the direction of the beam
50 039	**source-to-object distance**	*In radiography*, distance between the radiation source and the source side of the test object, measured along the central axis of the beam
50 040	**run-on test plate**	test piece made by adding plates to the beginning of a joint to give an extension of the weld for test purposes
50 041	**run-off test plate**	test piece made by adding plates to the end of a joint to give an extension of the weld for test purposes
50 042	**transverse tensile specimen**	test specimen for a tensile test that is transversely bisected by the portion of the weld included in it
50 043	**reverse bend test**	bend test in which the face other than that specified for a face bend test is in tension
50 044	**guided bend test**	bend test made by bending the specimen round a specific former
50 045	**controlled bend test**	guided bend test in which special means are incorporated in the bending apparatus so that the specimen follows the shape of the former during bending

No.	Term	Definition
50 046	**free bend test**	bend test made without using a former
50 047	**restrained weld test**	cracking test in which the parts to be welded are secured to prevent all controllable movement during and after welding
50 048	**U-tensile test**	method of tensile testing spot or projection welds; after welding, the test plates are bent in a U shape (see Figure 91) and the specimen is then pulled apart

Figure 91 **U-tensile test specimen**



No.	Term	Definition
50 049	**nick-break test**	fracture test in which a specimen is broken from a notch cut at a predetermined position where the interior of the weld is to be examined
50 050	**cruciform test piece; cruciform test specimen**	1) flat plate to which two other flat plates are welded at right angles and on the same axis [see Figure 92a)] 2) flat plate to which two bars are welded at right angles and on the same axis [see Figure 92b)] 3) transverse section cut from the middle of 1) at right angles to the weld direction (see Figure 93)

Figure 92 **Cruciform test pieces**

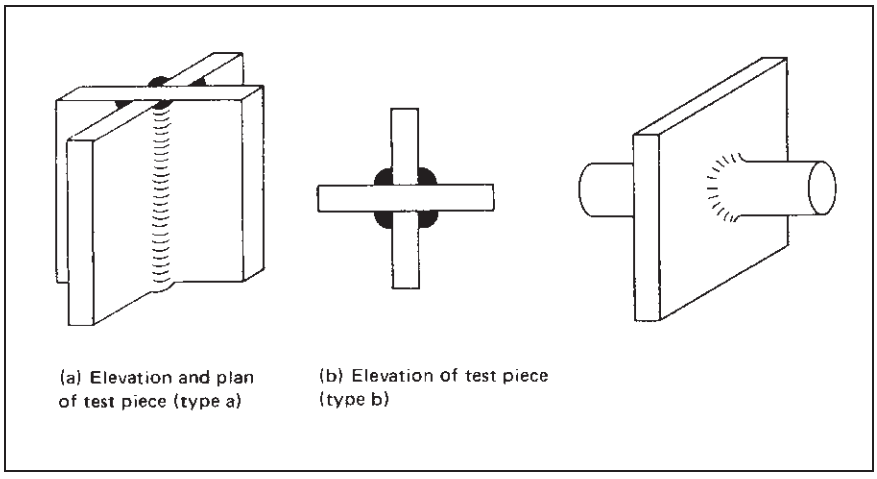
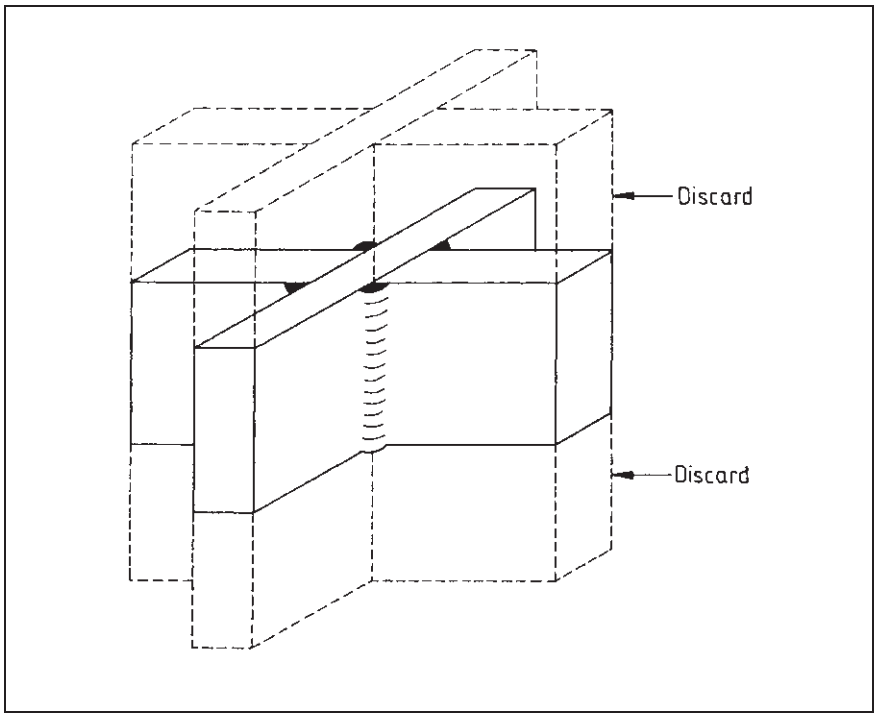
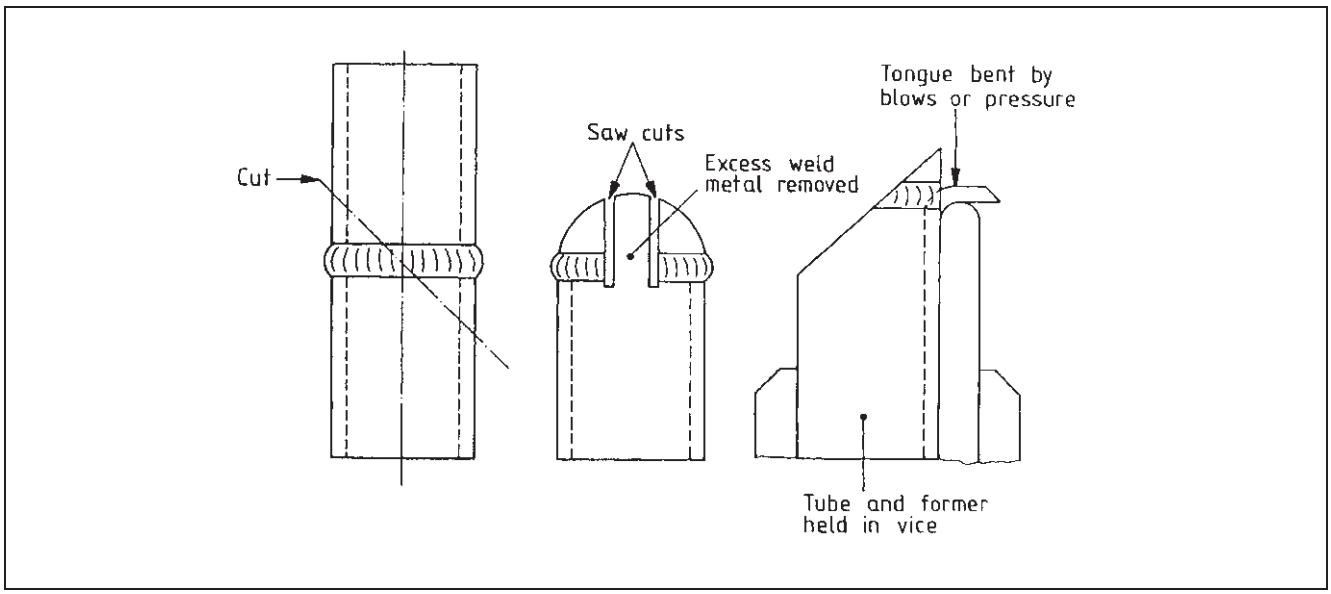


Figure 93 **Method of obtaining cruciform test specimen**



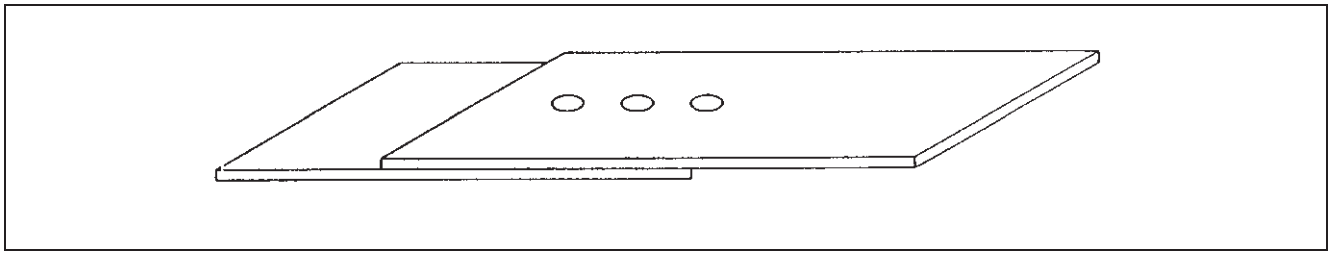
No.	Term	Definition
50 051	**cruciform test**	test in which a cruciform test specimen is tested in tension
50 052	**tongue-bend test specimen**	portion so cut in two straight lengths of pipe joined by a butt weld as to produce a tongue containing a portion of the weld; the cuts are made so that the tongue is parallel to the axis of the pipes and the weld is tested by bending the tongue round a former (see Figure 94)

Figure 94 **Tongue-bend test specimen**



No.	Term	Definition
50 053	**flattening test**	test in which a welded pipe joint is flattened until the internal walls are a specified distance apart
50 054	**cross tension test**	mechanical test in which a spot welded joint between overlapping sheets is tested by stressing normal to the faying surface
50 055	**shear test piece; shear test specimen**	1) test piece of overlapping plates incorporating an agreed number of spot or projection welds (usually not more than three) (see Figure 95) *NOTE This should not be confused with a shear test piece used for other purposes.* 2) test piece as described in 1) prepared for testing in a tensile test machine by drilling out or otherwise rendering ineffective those welds not to be tested

Figure 95 **Shear test piece**

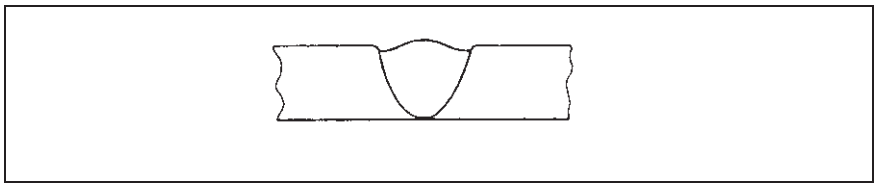


No.	Term	Definition
50 056	**pillow test**	test, usually for seam welding, in which two plates of similar dimensions are placed flat on top of one another so that the edges approximately coincide; they are then welded together and hydraulic pressure is applied between the sheets causing them to form a ''pillow''
50 057	**peaking**	deviation from the desired curvature of a bend test specimen caused by differences in mechanical properties of parts of the specimen

Section 6. Terms relating to weld imperfections

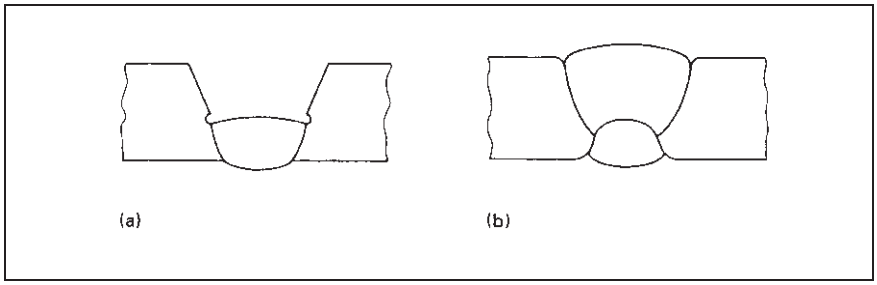
No.	Term	Definition
60 001	**imperfection**	discontinuity in the weld or a deviation from the intended geometry *NOTE Imperfections are, e.g. cracks, lack of penetration, porosity, slag inclusions.*
60 002	**metallurgical deviation**	*in welding*, changes in the mechanical properties and/or metallurgical structure of the weld metal or heat affected zone compared to the properties of the parent metal
60 003	**excessive penetration**	*NOTE Alternative term for ''excess penetration'' (see 60 040).*
60 004	**incompletely filled groove**	continuous or intermittent channel in the surface of a weld, running along its length, due to insufficient weld metal *NOTE The channel can be along the centre or along one or both edges of the weld. (see Figure 96)*

Figure 96 **Incompletely filled groove**



No.	Term	Definition
60 005	**undercut**	irregular groove at a toe of a run in the parent metal, or in previously deposited weld metal, due to welding (see Figure 97)

Figure 97 **Undercut**



No.	Term	Definition
60 006	**continuous undercut**	undercut of significant depth without interruption
60 007	**intermittent undercut**	short lengths of undercut, intermittent along the weld
60 008	**overlap** cold lapping	imperfection at a toe or root of a weld caused by metal flowing on to the surface of the parent metal without fusing to it
60 009	**evaluation level**	test level above which an indication is evaluated
60 010	**surface pitting**	imperfection in the surface of the parent metal usually in the form of small depressions

No.	Term	Definition
60 011	**crack**	linear discontinuity produced by fracture *NOTE Cracks may be longitudinal, transverse, edge, crater, centreline, fusion zone, underbead, weld metal or parent metal.*
60 012	**hot crack** solidification crack	material separations occurring at high temperatures along the grain boundaries (dendrite boundaries) when the level of strain and the strain rate exceed a certain level
60 013	**cold crack**	local rupture (intergranular or transgranular) appearing as a result of a critical combination of microstructure, stress and hydrogen content
60 014	**lack of fusion**	lack of union in a weld: a) between weld metal and parent metal, or b) between parent metal and parent metal, or c) between weld metal and weld metal
60 015	**lack of sidewall fusion**	lack of union between weld metal and parent metal at a side of a weld (see Figure 98)
60 016	**lack of root fusion**	lack of union at the root of a joint (see Figure 99)

Figure 98 **Lack of sidewall fusion**

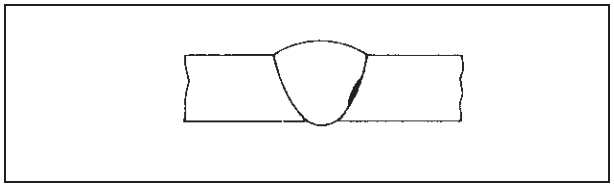
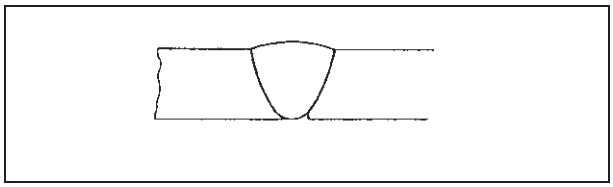
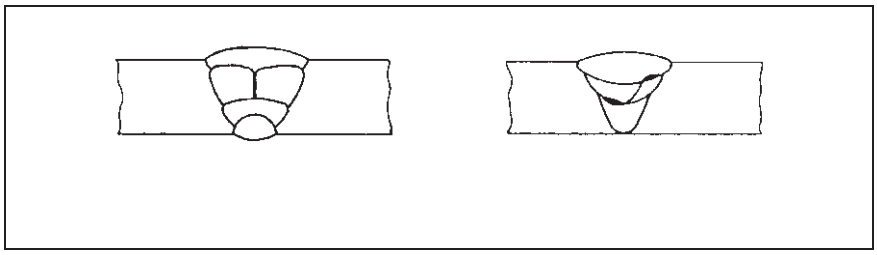


Figure 99 **Lack of root fusion**



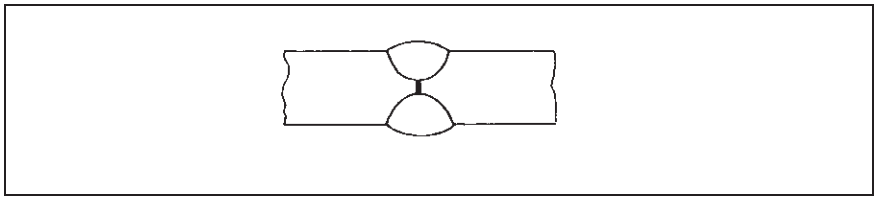
No.	Term	Definition
60 017	**lack of inter-run fusion**	lack of union between adjacent runs of weld metal in a multi-run weld (see Figure 100)

Figure 100 **Lack of inter-run fusion**



No.	Term	Definition
60 018	**incomplete penetration**	failure of weld metal to extend into the root of a joint (see Figure 101)

Figure 101 **Incomplete root penetration**



No.	Term	Definition
60 019	**solidification crack**	hot crack formed during solidification from the liquid phase of weld metals *NOTE It usually extends up to the surface of the weld metal, but sometimes can be subsurface.*
60 020	**inclusion**	slag, flux, oxide, copper, tungsten or other foreign matter entrapped during welding; the defect is usually more irregular in shape than a gas pore; inclusions can be linear, isolated or clustered in their formation
60 021	**linear inclusion** slag line	inclusion of linear form situated parallel to the axis of a weld
60 022	**solid inclusion**	solid foreign substances entrapped in the solid metal
60 023	**oxide inclusion**	metallic oxide entrapped during welding
60 024	**tungsten inclusion**	inclusion of tungsten from the electrode in tungsten inert-gas welding
60 025	**copper inclusion**	inclusion of copper due to the accidental melting of the contact tube or nozzle in self-adjusting and controlled-arc welding, or to pick-up by contact between the copper nozzle and the molten pool in tungsten inert-gas welding
60 026	**gas pore**	spherical cavity, generally under 1.5 mm in diameter, formed by entrapped gas during the solidification of molten metal
60 027	**gas cavity**	cavity formed by entrapped gas
60 028	**porosity**	group of gas pores
60 029	**indication**	*in non-destructive testing*, representation or signal from a discontinuity
60 030	**uniformly distributed porosity**	porosity distributed in a substantially uniform manner throughout a weld
60 031	**localized porosity**	porosity confined to a small area of a weld
60 032	**linear porosity**	string of gas pores situated parallel to the axis of a weld
60 033	**elongated cavity**	cavity occurring at the root of a weld due to the use of unstable arc conditions
60 034	**shrinkage cavity**	cavity due to the shrinkage of metal whilst in a plastic condition
60 035	**wormhole** pipe: *deprecated*	elongated to tubular cavity formed by entrapped gas during the solidification of molten metal
60 036	**burn-through** melt-through	localized collapse of the molten pool due to excessive penetration, resulting in a hole in the weld run
60 037	**internal imperfection**	imperfection that is not open to a surface or not directly accessible
60 038	**systematic imperfection**	imperfections that are repeatedly distributed in the weld over the weld lengths to be examined
60 039	**stray arc**	damage on the parent material resulting from the accidental striking of an arc away from the weld
60 040	**excess penetration**	excess weld metal protruding through the root of a fusion weld made from one side only (see Figure 102)
60 041	**root concavity** suck-back; underwashing	shallow groove that may occur in the root of a butt weld (see Figure 103)

Figure 102 **Excess penetration bead**

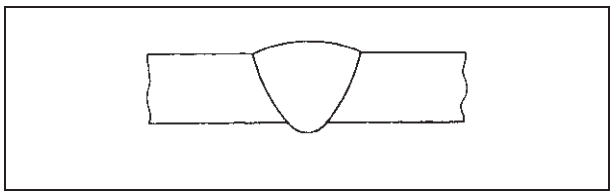
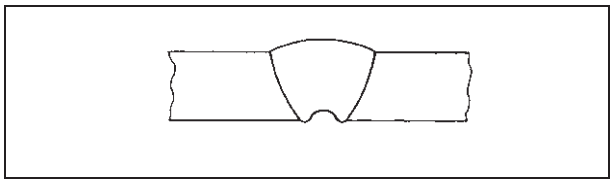
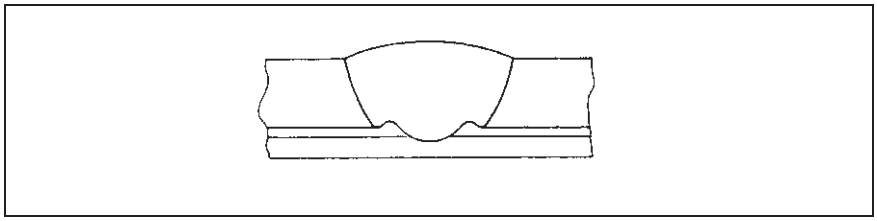


Figure 103 **Root concavity**



No.	Term	Definition
60 042	**shrinkage groove**	shallow groove caused by contraction in the metal along each side of a penetration bead (see Figure 104)

Figure 104 **Shrinkage groove**



No.	Term	Definition
60 043	**metal run-out**	molten metal inadvertently lost from a weld by gravitational flow *NOTE The term is used mainly in submerged-arc welding, where the effect arises from incorrect edge preparation.*
60 044	**sagged weld**	weld in which the parent metal has been excessively softened during welding allowing the weld and adjacent parent metal to sag
60 045	**excessive dressing** underflushing	reduction in metal thickness caused by the removal of the surface of a weld and adjacent areas to below the surface of the parent metal
60 046	**grinding mark**	grooves in the surface of parent metal or of a weld made by a grinding wheel or surfacing tool
60 047	**tool mark** chipping mark	indentation in the surface of parent metal or of a weld, resulting from the application of a tool, e.g. a chipping tool, in preparation or dressing
60 048	**hammer mark**	indentation in the surface of parent metal or of a weld due to a hammer blow
60 049	**torn surface**	surface irregularity due to the breaking off of temporary attachments
60 050	**slag trap**	configuration in a joint or joint preparation that may lead to the entrapment of slag
60 051	**blowhole**	cavity, generally over 1.5 mm in diameter, formed by entrapped gas during the solidification of molten metal
60 052	**crater pipe**	depression due to shrinkage at the end of a run where the source of heat was removed
60 053	**puckering**	formation of an oxide-covered weld run or bead with irregular surfaces and with deeply entrained oxide films, that can occur when materials forming refractory oxides (e.g. aluminium and its alloys) are being welded

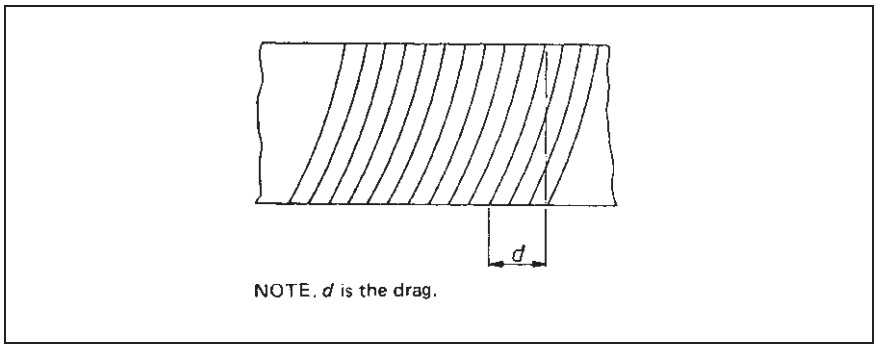
No.	Term	Definition
60 054	**fish eye**	small bright area of cleavage fracture, caused by the presence of hydrogen, that is visible only on the fractured surface of weld metal
60 055	**flat spot**	area in a flash weld, revealed by breakage of the joint, that has a shiny or relatively very smooth appearance and is roughly circular in shape with perhaps narrow streaks radiating from it
60 056	**intrusion**	projection of fused metal extending into the heat-affected zone of a resistance weld; an oxide or slag inclusion at the edge of a manual metal arc weld
60 057	**lamellar tear**	sub-surface crack in wrought parent material orientated parallel to the fusion boundary but located in or just beyond the heat affected zone, characterized by a series of de-cohered non-metallic inclusions linked by tearing in a step-wise morphology *NOTE This tearing is the result of thermal welding strains in the through-thickness direction in material which has low through-thickness ductility due to the presence of such inclusions in the rolling plane. It is usually associated with cruciform, T and corner joints.*

Section 7. Terms relating to cutting

Subsection 70. Terms relating to more than one subsection

No.	Term	Definition
70 001	**stack cutting**	thermal cutting of a stack of plates usually clamped together
70 002	**oxygen-arc cutting**	thermal cutting in which ignition temperature is produced by an electric arc, and cutting oxygen is conveyed through the centre of an electrode, which is consumed in the process
70 003	**gouging (thermal)**	forming of a groove by means of thermal cutting
70 004	**flame gouging**	gouging using the principles of oxyfuel flame cutting
70 005	**arc gouging**	gouging using an arc cutting process variation
70 006	**kerf**	void left after metal has been removed in thermal cutting
70 007	**waterjet cutting**	process by which a high pressure water jet is used to erode a narrow channel in a material, with or without added abrasive grit
70 008	**oxygen cutting**	thermal cutting process using an oxygen/fuel gas flame to preheat the material to its ignition temperature and an oxygen jet to oxidize and remove material
70 009	**cutting blowpipe**	torch used in oxygen cutting for controlling the gases used to produce ignition temperature and for controlling and directing the stream of combustion gases
70 010	**flame cutting**	See **oxygen cutting** 70 008.
70 011	**powder cutting**	oxyfuel flame cutting in which a suitable powder is injected into the cutting oxygen stream to assist the cutting action
70 012	**oxygen lance**	steel tube, heated to its ignition point and consumed during operation, through which oxygen passes *NOTE The lance is packed with rods or else powder is fed through the lance.*
70 013	**air-arc cutting**	thermal cutting process that uses the heat of an arc and cutting oxygen
70 014	**plasma arc cutting**	arc cutting process that uses a constricted arc and removes the molten metal with a high-velocity jet of ionized gas issuing from the constricting orifice
70 015	**laser cutting**	thermal cutting process usually supported by a gas jet which uses a focused laser beam of such intensity that it melts and vaporizes the material *NOTE A distinction is made between laser oxyfuel flame cutting, laser fusion cutting and laser sublimation cutting.*
70 016	**gas jet laser cutting**	See **oxygen cutting** 70 008.
70 017	**thermal cutting**	parting or shaping of materials by the application of heat with or without a stream of cutting oxygen
70 018	**drag line**	serration left on the face of a cut made by thermal cutting
70 019	**drag**	projected distance between the two ends of a drag line (see Figure 105)

Figure 105 **Drag**



NOTE. d is the drag.

No.	Term	Definition
70 020	**underwater cutting**	thermal cutting at such a depth below water level that the cutting action does not break the water surface
70 021	**cutting head**	one or more machine cutting blowpipes or plasma torches mounted together for making one or more cuts to produce the required edge profile
70 022	**cutter steering system** steering system	arrangement on a cutting machine for guiding and controlling the cutting head(s) along a desired path
70 023	**cutting machine**	thermal cutting equipment together with holding and moving devices for cutting metals
70 024	**articulated-arm cutting machine**	cutting machine with a hinged arm on which a cutting blowpipe or plasma torch and template following device are mounted in line with each other on the free end of the arm
70 025	**cross-carriage cutting machine**	cutting machine with longitudinal and transverse carriages to move the cutting head and to permit profiling
70 026	**single-cantilever cutting machine**	cross-carriage cutting machine with a cutting area beneath a cutting head or heads mounted on a transverse cantilever carriage extending over one side of longitudinal tracks (see Figure 106)
70 027	**double-cantilever cutting machine**	cross-carriage cutting machine with two cutting areas each beneath a cutting head or heads mounted on a transverse cantilever extending over each side of the carriage (see Figure 107)
70 028	**extended boom single-cantilever cutting machine**	single-cantilever cutting machine with the cantilever lengthened to accommodate two cutting areas side by side (see Figure 108)
70 029	**portal cutting machine** gantry cutting machine	cross-carriage cutting machine with a cutting area beneath a cutting head or heads mounted on the transverse carriage between the longitudinal tracks (see Figure 109)
70 030	**double-portal cutting machine**	portal cutting machine with two cutting areas side by side (see Figure 110)
70 031	**portal-cantilever cutting machine**	combination of a portal and a single-cantilever cutting machine (see Figure 111)

Figure 106 **Single-cantilever cutting machine**

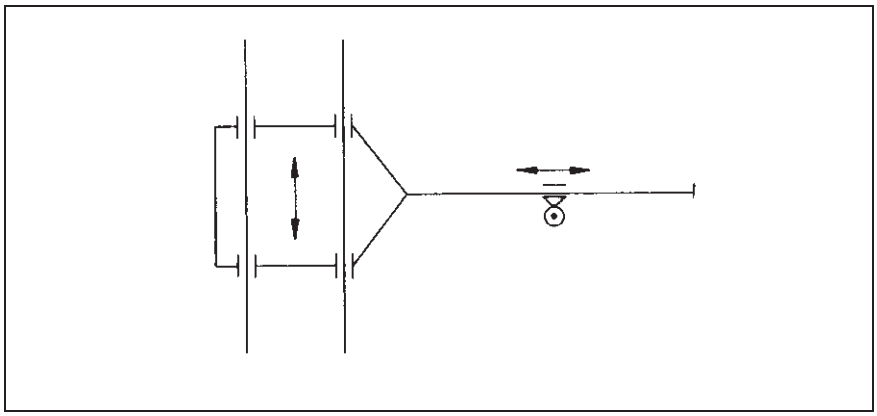


Figure 107 **Double-cantilever cutting machine**

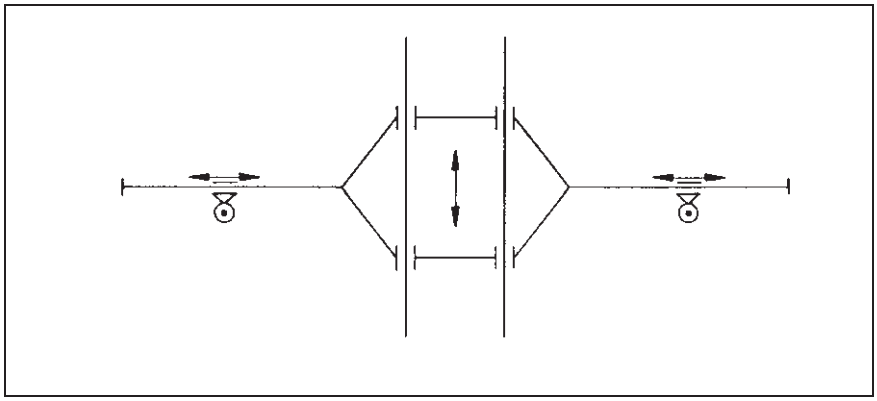


Figure 108 **Extended boom single-cantilever cutting machine**

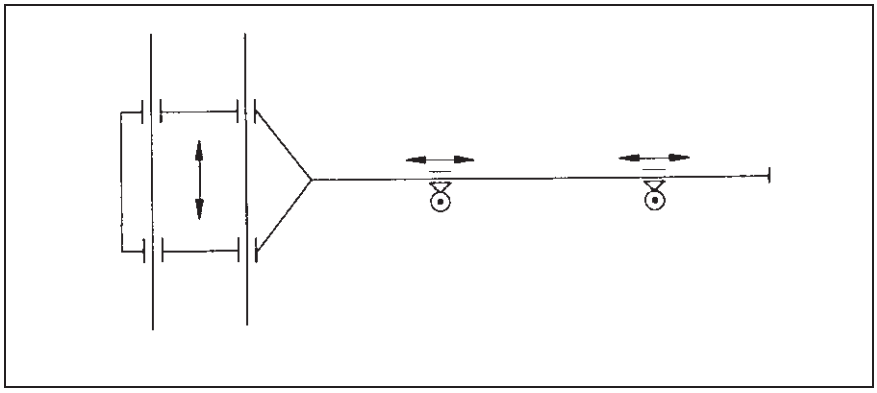


Figure 109 **Portal cutting machine**

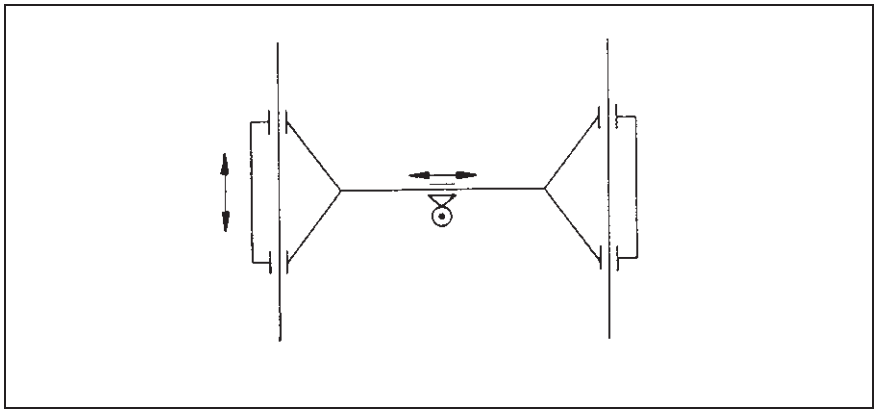


Figure 110 **Double-portal cutting machine**

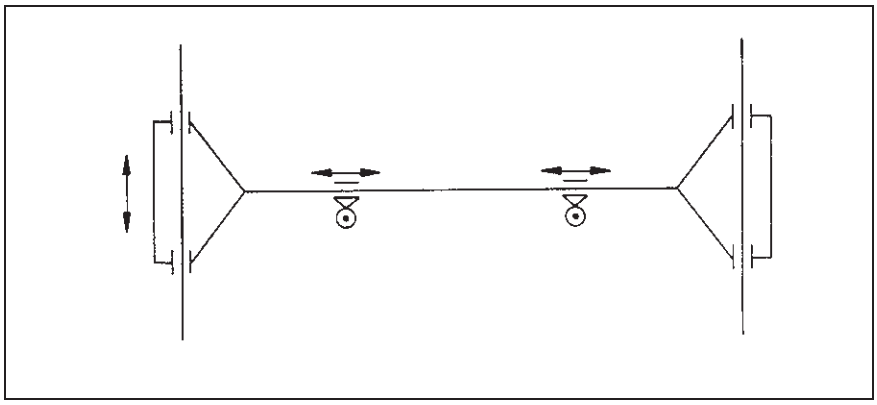
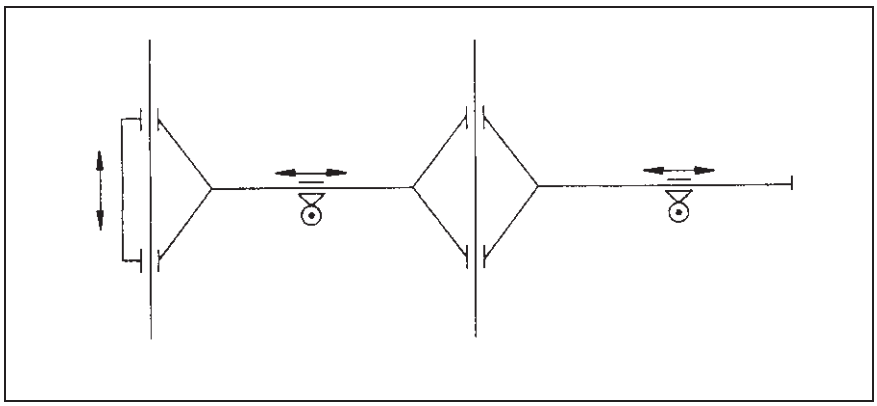


Figure 111 **Portal-cantilever cutting machine**



Subsection 71. Terms relating only to oxygen cutting

No.	Term	Definition
71 001	**oxygen cutting** gas cutting: *deprecated*	thermal cutting of material by chemical reaction with oxygen after the appropriate part has been raised to ignition temperature
71 002	**flame cutting**	oxygen cutting in which the appropriate part of the material to be cut is raised to ignition temperature by an oxy-fuel gas flame
71 003	**preheating oxygen**	oxygen used at a suitable pressure in conjunction with fuel gas for raising to ignition temperature the metal to be cut
71 004	**cutting oxygen**	oxygen used at a pressure suitable for oxygen cutting
71 005	**de-seaming**	removal of surface defects from ingots, blooms, billets and slabs by means of manual thermal cutting
71 006	**scarfing** de-surfacing	removal of the surface or surfaces from blooms, billets and slabs by means of a flame cutting machine
71 007	**hot cropping**	oxygen cutting of hot ingots, blooms, billets and slabs to required lengths
71 008	**powder cutting**	oxyfuel flame cutting in which a suitable powder is injected into the cutting oxygen stream to assist the cutting action
71 009	**flame washing**	method of surface shaping and dressing of metal by flame cutting using a nozzle designed to produce a suitably shaped cutting oxygen stream

No.	Term	Definition
71 010	**powder washing**	flame washing with the introduction of powder into the cutting oxygen stream
71 011	**oxygen lancing**	oxyfuel flame cutting that uses an oxygen lance to produce holes or openings in a material
71 012	**cutting blowpipe**	device used in oxygen cutting for controlling the gases used to produce ignition temperature and for controlling and directing the stream of cutting oxygen
71 013	**gouging blowpipe**	cutting blowpipe with a nozzle designed for gouging
71 014	**dual fuel blowpipe**	oxygen cutting blowpipe that allows the use of an admixture of two fuel gases
71 015	**flame planing machine**	oxygen cutting machine capable of cutting a number of edges of a plate or plates simultaneously
71 016	**cutter guide**	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
71 017	**floating head**	blowpipe holder on a flame cutting machine that, through a suitable linkage, is designed to follow the contour of the surface of the plate, thereby enabling the correct nozzle-to-workpiece distance to be maintained
71 018	**venturi nozzle** convergent/divergent nozzle	oxygen cutting nozzle designed to provide a high velocity cutting oxygen stream of approximately constant cross section
71 019	**oxygen lance**	steel tube, heated to its ignition point and consumed during operation, through which oxygen passes
71 020	**packed lance**	oxygen lance packed with steel rods or wires
71 021	**powder lance**	oxygen lance in which powder is mixed with the oxygen stream
71 022	**de-scaling blowpipe** flame cleaning blowpipe	blowpipe fitted with a nozzle designed to give suitable flame conditions for spalling scale and removing particles from the surface of a workpiece
71 023	**de-seaming blowpipe** scarfing torch	blowpipe fitted with a nozzle suitable for de-seaming
71 024	**rivet cutting blowpipe**	blowpipe with a special nozzle for flame cutting off the protruding heads of rivets to facilitate their removal
71 025	**tube cutting blowpipe**	blowpipe fitted with a special nozzle designed to cut tubes from the inside
71 026	**cutter head**	part of a cutting blowpipe to which a nozzle is fitted
71 027	**cutting oxygen bore**	portion of the nozzle that controls the shape of the cutting oxygen stream leaving the orifice
71 028	**parallel bore nozzle**	oxygen cutting nozzle with a cylindrical cutting oxygen bore
71 029	**step-type nozzle** sheet metal nozzle	one-piece oxygen cutting nozzle with a single leading preheat orifice situated on a step at the end of the nozzle and a trailing cutting oxygen bore *NOTE The nozzle is held in contact with the workpiece surface.*
71 030	**multi-preheat cutting nozzle** multi-flame cutting nozzle	oxygen cutting nozzle with more than one orifice for the preheat gases

No.	Term	Definition
71 031	**annular preheat cutting nozzle** annular flame cutting nozzle	oxygen cutting nozzle with an annular slot orifice for the preheat gases
71 032	**one-piece nozzle**	oxygen cutting nozzle that is integral and contains the preheat and cutting oxygen gasways and bores
71 033	**nozzle skirt**	extension of the outer walls of an oxygen cutting nozzle beyond the preheat and cutting oxygen orifices *NOTE A skirt is generally used for nozzles that are used with propane gas.*
71 034	**wheel guide** roller guide	cutter guide fitted with one or two wheels that are in contact with the workpiece during cutting
71 035	**spade guide**	cutter guide fitted with one or two small plates that are in contact with the workpiece during cutting
71 036	**flame planing unit**	parts of a flame planing machine that cut one edge of a plate
71 037	**rip-trim cutter**	cutting blowpipe attached to and leading a cutting head that is used to make an initial plate edge trimming cut in front of the cutting head
71 038	**rivet washing**	progressive washing away, by oxygen cutting, of a rivet head and part of its shank for purposes of removal
71 039	**rivet piercing**	removal of a rivet by initially piercing a hole through it by oxygen cutting

Subsection 72. Terms relating only to arc cutting

No.	Term	Definition
72 001	**carbon-arc cutting**	thermal cutting by melting using the heat of an arc between a carbon electrode and the metal to be cut
72 002	**metal-arc cutting**	thermal cutting by melting using the heat of an arc between a metal electrode and the metal to be cut
72 003	**air-arc cutting**	thermal cutting using an arc for melting the metal and a stream of air to remove the molten metal to enable a cut to be made
72 004	**cutting electrode**	electrode with a covering that aids the production of such an arc that molten metal is blown away to produce a curve or cut in the work
72 005	**plasma arc cutting**	cutting with a plasma arc in which the constricted arc melts a narrow region of metal which is then blown away by the force of the arc
72 006	**arc cutting**	thermal cutting by melting the metal to be cut using the heat of an arc

Subsection 73. Terms relating only to spark erosion cutting

No.	Term	Definition
73 001	**spark erosion cutting**	cutting by means of the eroding action of a recurring series of sparks between an electrode and the workpiece

Subsection 74. Terms relating only to electron beam cutting

No.	Term	Definition
74 001	**electron beam cutting**	thermal cutting in vacuum by melting and vaporizing a narrow section of metal by the impact of a focused beam of electrons

Subsection 75. Terms relating only to laser cutting

No.	Term	Definition
75 015	**laser cutting**	thermal cutting using the energy from a laser beam focused to a sufficiently high intensity to remove material by vaporization (typical of non-metals) or by a combination of vaporization and liquid-phase ejection (typical of metals)
75 016	**gas jet laser cutting**	laser cutting with the addition of a gas jet directed to the point at which the beam meets the workpiece *NOTE With metals the gas can either be oxidizing (for example in the case of CMn steel) which reacts with the heated metal to effect the cut, or inert (for example in the case of stainless steel) if a smooth surface with a smaller HAZ is required compared to oxidizing cutting; with non-metals a substantially inert gas is used which acts to cool the cut edge and prevent damage.*

Section 8. Terms relating to health and safety

No.	Term	Definition
80 001	**air sampling**	process consisting of the collection, withdrawal or isolation of a fractional part of a larger volume of air *NOTE It may include the simultaneous isolation of selected components.*
80 003	**breathing zone**	space around the worker's face from where the worker breathes
80 004	**headband**	part of the harness to which the welder's face shield is fixed and which surrounds the head, or part of the welder's goggles or welder's spectacles which secures them onto the head
80 005	**time weighted average concentration**	concentration of a chemical agent in the atmosphere, averaged over a reference period
80 006	**total airborne particles**	all particles surrounded by air in a given volume of air
80 007	**face shield** hand shield hand screen welder's shield	protective device held in the hand to shield the face and throat from injury during welding, fitted with a window consisting of welding glass and plain glass, and if necessary a heat filter

Bibliography

BS 499-1/IEV 50 (851):1991, Supplement, *Welding terms and symbols – Supplement – Definitions for electric welding equipment*

BS 499-2c, *Welding terms and symbols – European arc welding symbols in chart form*

BS EN 1011-1, *Welding – Recommendations for welding of metallic materials – Part 1: General guidance for arc welding*

BS EN 1792, *Welding – Multilingual list of terms for welding and related processes*

BS EN 13622, *Gas welding equipment – Terminology – Terms used for gas welding equipment*

BS EN 22553, *Welded, brazed and soldered joints – Symbolic representation on drawings*

BS EN ISO 14555, *Welding – Arc stud welding of metallic materials*

BS EN ISO 15607, *Specification and qualification of welding procedures for metallic materials – General rules*

BS EN ISO 17659, *Welding – Multilingual terms for welded joints with illustrations*

BS ISO 857-2, *Welding and allied processes – Vocabulary – Part 2: Soldering and brazing processes and related terms*

PD CEN/TR 14599, *Terms and definitions for welding purposes in relation with EN 1792*

ISO 857-1, *Welding and allied processes – Vocabulary – Part 1: Metal welding processes*

ISO/DIS 25239-1, *Friction stir welding – Aluminium – Part 1: Vocabulary*

British Standards Institution (BSI)

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level.

It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.

Tel: +44 (0)20 8996 9000 Fax: +44 (0)20 8996 7400

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to BSI Customer Services.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001
Email: orders@bsigroup.com

You may also buy directly using a debit/credit card from the BSI Shop on the website **www.bsigroup.com/shop**

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library.

Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre.

Tel: +44 (0)20 8996 7111
Fax: +44 (0)20 8996 7048 Email: info@bsigroup.com

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration.

Tel: +44 (0)20 8996 7002 Fax: +44 (0)20 8996 7001
Email: membership@bsigroup.com

Information regarding online access to British Standards via British Standards Online can be found at **www.bsigroup.com/BSOL**

Further information about BSI is available on the BSI website at **www.bsigroup.com**

Copyright

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/standards

raising standards worldwide™

British Standards

This page deliberately left blank

This page deliberately left blank

British Standards Institution (BSI)

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level.

It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.

Tel: +44 (0)20 8996 9000 Fax: +44 (0)20 8996 7400

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to BSI Customer Services.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001
Email: orders@bsigroup.com

You may also buy directly using a debit/credit card from the BSI Shop on the website **www.bsigroup.com/shop**

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Library.

Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre.

Tel: +44 (0)20 8996 7111
Fax: +44 (0)20 8996 7048 Email: info@bsigroup.com

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration.

Tel: +44 (0)20 8996 7002 Fax: +44 (0)20 8996 7001
Email: membership@bsigroup.com

Information regarding online access to British Standards via British Standards Online can be found at **www.bsigroup.com/BSOL**

Further information about BSI is available on the BSI website at **www.bsigroup.com**

Copyright

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/standards

raising standards worldwide™

British Standards