

Welding terms and symbols —

Part 1: Glossary for welding, brazing and thermal cutting

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- British Shipbuilders
- City and Guilds of London Institute (Advisory Committee)
- Institute of Metals
- Institution of Production Engineers
- Institution of Structural Engineers
- National Association of Teachers in Further and Higher Education
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Foreword

This Part of BS 499 has been prepared under the direction of the Welding Standards Policy Committee. This edition introduces technical changes but it does not reflect a full review or revision of the standard, which will be under taken in due course. It replaces BS 499-1:1983 which is withdrawn. There is, at present, a considerable amount of activity in the field of welding terminology in both European and international standardization and it was considered necessary to allow time for this work to be established before instituting a complete revision of this glossary. In the meantime, however, some amendment was felt to be necessary to keep the glossary up to date. The chief changes made were the addition of terms associated with robotic welding, amendments to the time and pressure diagrams for some resistance welding processes, the deletion of the subsection containing terms relating to forge welding and the addition of a figure showing a comparison of the designation of welding positions in the UK and internationally.

The glossary is arranged in classified sections similar to those of the previous edition. This layout makes it possible to find either a term to convey a particular meaning or, in conjunction with the alphabetical index, the meaning of a particular term. It is apparent, therefore, that considerable advantages are achieved over a purely alphabetical list of terms which presupposes knowledge of the term in question.

Charts showing the derivation of welding, cutting and allied processes are given in Figure 1, Figure 2 and Figure 3. Appendix A to Appendix G give guidance on typical information to appear on a welding procedure sheet for various types of welding process the range of which having been extended from that of the previous edition.

Preferred and equivalent terms are given in bold type, non-preferred terms are given in medium type and deprecated terms are given in medium type with their status indicated.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 127 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

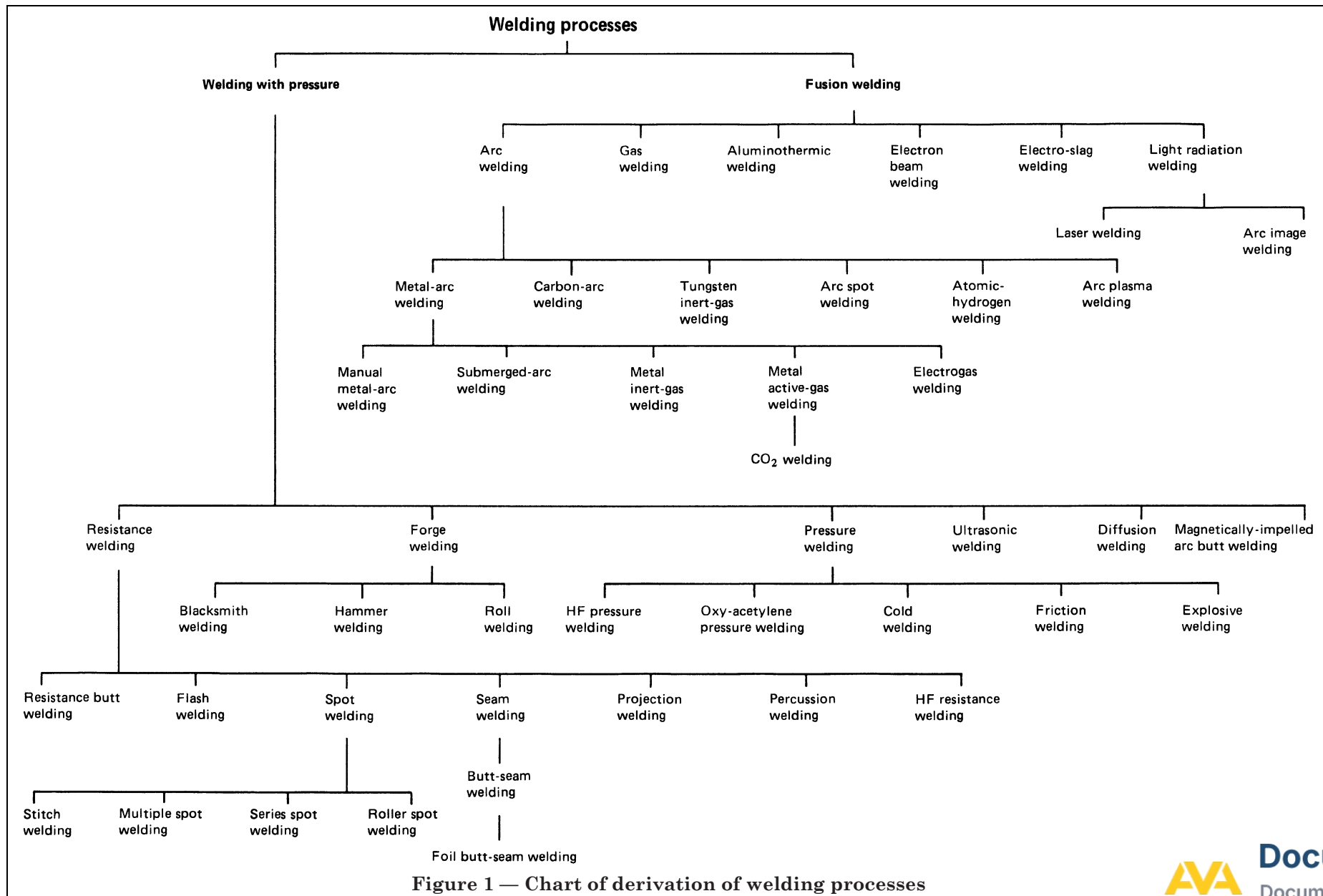


Figure 1 — Chart of derivation of welding processes

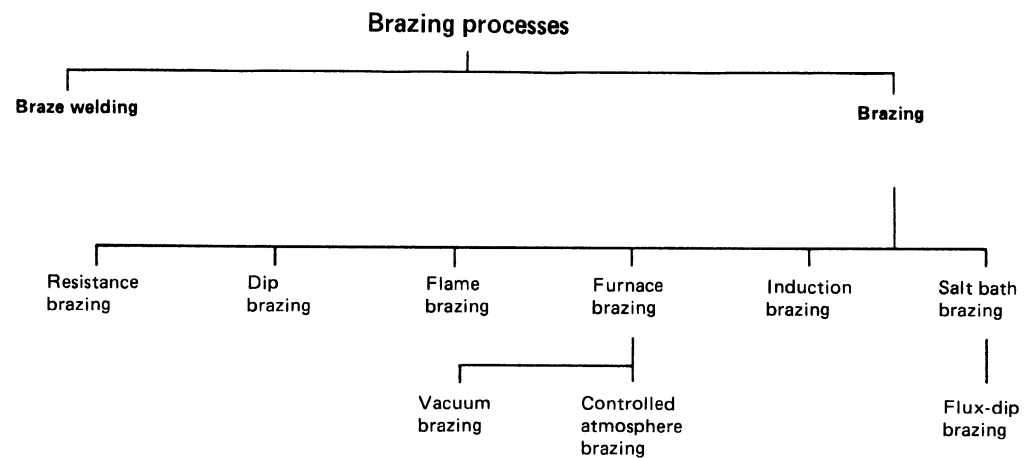


Figure 2 — Chart of derivation of brazing processes

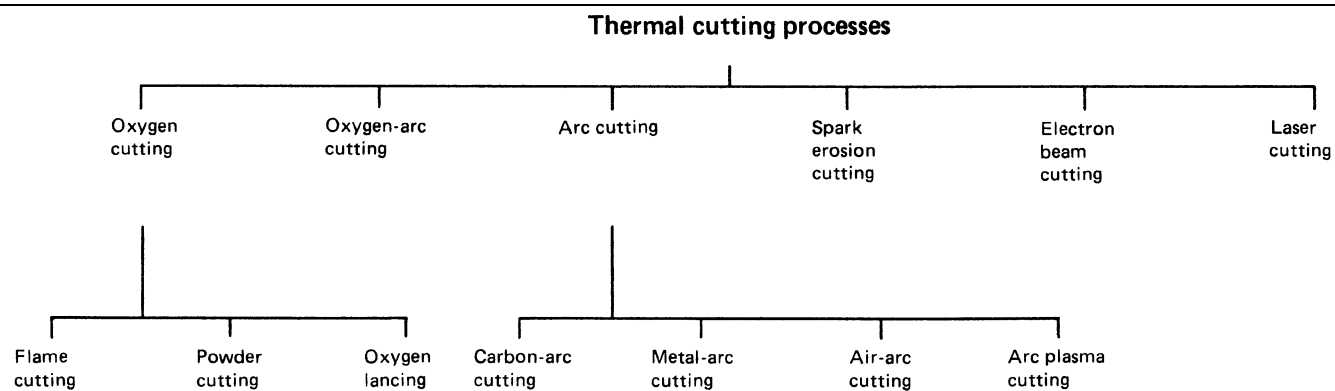
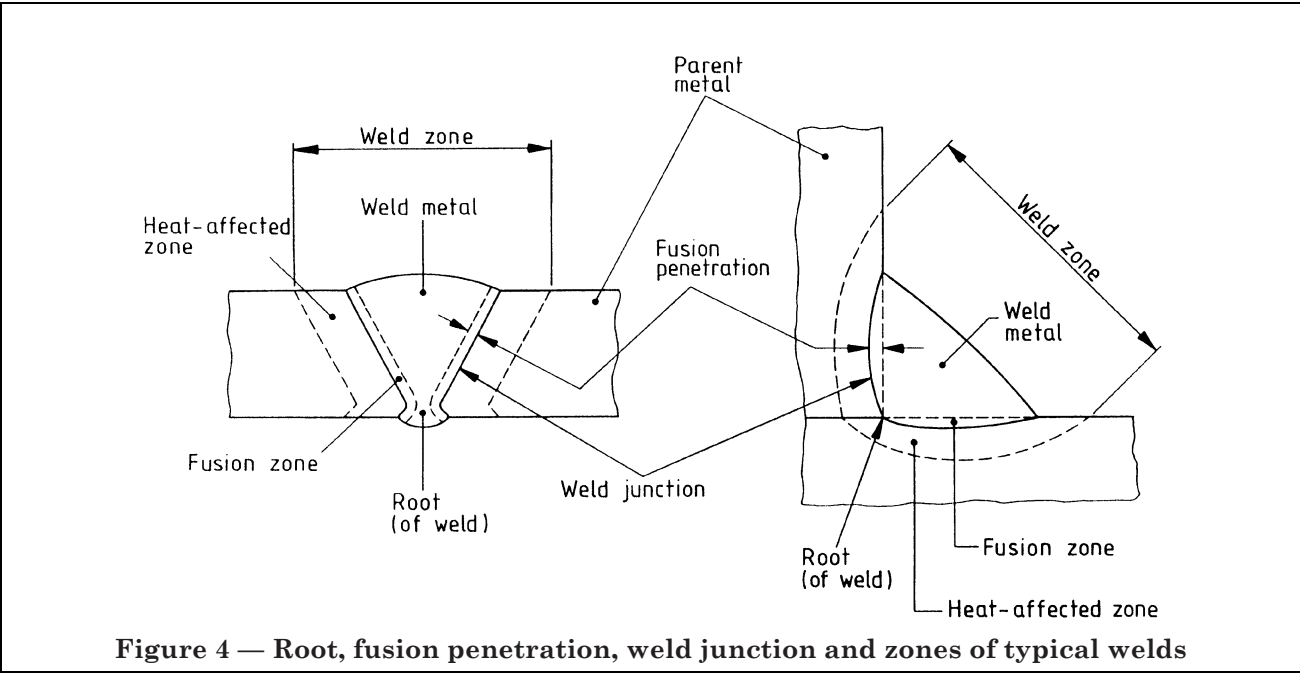


Figure 3 — Chart of derivation of thermal cutting processes

Section 1. Terms common to more than one section

No.	Term	Definition
10 001	welding	An operation in which two or more parts are united, by means of heat or pressure or both, in such a way that there is continuity in the nature of the metal between these parts. A filler metal, the melting temperature of which is of the same order as that of the parent metal, may or may not be used.
10 002	weld	A union of pieces of metal made by welding.
10 003	welder	The operator who performs the welding.
10 004	welding plant welder: <i>deprecated</i>	The entire apparatus for providing and controlling energy, and movement if necessary, for making a weld.
10 005	welding process	A particular method of welding involving the application of certain metallurgical, electrical, physical, chemical or mechanical principles.
10 006	automatic welding	Welding in which all the welding parameters are controlled. Manual adjustments may be made between welding operations but not during welding.
10 007	semi-automatic welding	Welding in which some of the welding parameters, such as arc length, are automatically controlled, but manual guidance is necessary.
10 008	shop weld	A weld made within the premises of the manufacturer of the welded assembly.
10 009	site weld	A weld made at the location where the assembly is to be installed.
10 010	strength weld	A weld designed to withstand stress.
10 011	parent metal base metal: <i>deprecated</i>	Metal to be joined or surfaced by welding, braze welding or brazing. (See Figure 4.)
10 012	filler metal	Metal added during welding, braze welding, brazing or surfacing.
10 013	filler wire welding wire	Filler metal in the form of a coil of wire.
10 014	filler rod welding rod: <i>deprecated</i>	Filler metal in the form of a rod.

No.	Term	Definition
10 015	covered filler rod coated filler rod: <i>deprecated</i>	A filler rod having a covering of flux.
10 016	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. In arc welding, many other substances, which perform special functions, are added.
10 017	deposited metal	Filler metal after it becomes part of a weld or joint.
10 018	weld metal	All metal melted during the making of a weld and retained in the weld. (See Figure 4.)
10 019	run pass	The metal melted or deposited during one passage of an electrode, torch or blowpipe.



10 020	deposition rate	The mass of metal deposited in a unit of time.
10 021	weld zone	The zone containing the weld metal and the heat-affected zone. (See Figure 4.)
10 022	heat-affected zone (abbrev. HAZ)	The part of the parent metal that is metallurgically affected by the heat of welding or thermal cutting, but not melted. (See Figure 4.)
10 023	fusion zone	The part of the parent metal that is melted into the weld metal. (See Figure 4.)

No.	Term	Definition
10 024	weld junction	The boundary between the fusion zone and the heat-affected zone. (See Figure 4.)
10 025	welding technique	The manner in which an operator manipulates an electrode, a blowpipe or a similar appliance.
10 026	welding procedure	A specific course of action followed in welding, including a list of materials and, where necessary, tools to be used. (See Appendix A to Appendix G.)
10 027	welding procedure test	The 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.
10 028	approved welding procedure	A documented welding procedure that has been approved by an inspecting authority either by means of a welding procedure test or as a result of authentic documented experience gained with the welding of joints similar to that to which the welding procedure applies.
10 029	welding sequence	The order and direction in which joints, welds or runs are made.
10 030	fusion penetration	1) In fusion welding. The depth to which the parent metal has been fused. (See Figure 4.) 2) In spot, seam or projection welding. The distance from the interface to the edge of the weld nugget, measured in each case on a cross section through the centre of the weld and normal to the surface. (See Figure 7.)
10 031	stud welding	The joining of a metal stud or similar part to a workpiece. 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.
10 032	hard facing hard surfacing	The application of a hard, wear-resistant material to the surface of a component by welding, braze welding or spraying.
10 033	spatter	Globules of metal expelled during welding or cutting.
10 034	three-phase welding power source three-phase welding machine	A 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.
10 035	idling time	The time during which energy is available for welding but is not being used.

No.	Term	Definition
10 036	recovery time	The 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.
10 037	cycle	An arbitrary unit of time, of duration equal to that of one cycle of the alternating current supply. Normally in Great Britain this is 1/50 s.
10 038	duty cycle	1) In the sense of “welding operator” duty cycle, the 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, a measure of the capability of the welding equipment.
10 039	plasma	The region of ionized gas that generally forms the major portion of an arc column and provides a conducting path for the current.
10 040	nozzle-constricted arc	An arc that is constricted or shaped by nozzle walls.
10 041	vortex-constricted arc	An arc that is constricted by a vortex produced by swirling liquid or gas.
10 042	transferred arc	A constricted arc that is struck between an electrode mounted within a torch and the workpiece.
10 043	non-transferred arc	A constricted arc that is struck between an electrode within a torch and a second electrode which forms a nozzle through which the plasma flows.
10 044	partially transferred arc	A 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.

No.	Term	Definition
10 045	pick-up	1) In fusion welding. The transfer of alloying elements from the parent metal to the weld metal as a result of dilution. 2) In fusion welding. The property of a flux that causes some of it to adhere to the heated end of a filler rod, i.e. the property that gives rise to the “tuft” which is applied to the molten pool. 3) In resistance welding. The particles of the surface of the workpiece that adhere to the surface of the electrodes, or vice versa.
10 046	sleeve joint muff joint	A 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.
10 047	arc eye	Irritation of the eye caused by exposure to radiation from an electric arc.
10 048	electrode holder	A device to hold an electrode and to convey current to it.
10 049	welding glass filter glass	A filter to protect the eyes from harmful radiation during welding or cutting.
10 050	plain glass cover glass	Clear glass or other transparent material used to protect the surface of welding glass.
10 051	heat filter	A colourless, transparent, heat-absorbing glass plate placed between the plain glass and the welding glass to protect the eyes. It is usually used in high current metal inert-gas welding.
10 052	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.
10 053	welding goggles	A protective device enclosing a space in front of the eyes to shield them from injury during welding or cutting. They are fitted with welding glass and plain glass.
10 054	chipping goggles	A protective device enclosing a space in front of the eyes to shield them from injury during chipping, grinding or cutting. They are fitted with plain glass.

No.	Term	Definition
10 055	face mask	1) A protective device worn in front of the face to shield it from injury during welding or cutting. It is fitted with welding glass and plain glass. 2) A protective device supplied with fresh air and worn over the nose and mouth.
10 056	helmet head screen head shield	A protective device supported on the head and arranged to shield the face and throat from injury during welding. It is fitted with a window consisting of welding glass and plain glass, and if necessary a heat filter.
10 057	face shield hand shield hand screen	A protective device held in the hand to shield the face and throat from injury during welding. It is fitted with a window consisting of welding glass and plain glass, and if necessary a heat filter.
10 058	fixed shield	An independently mounted device to provide protection from injury during welding or cutting.
10 059	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.
10 060	blowpipe torch: <i>deprecated</i>	A device for mixing and burning gases to produce a flame for welding, brazing, braze welding, cutting, heating and similar operations. (See also terms 32 082 to 32 085.)
10 061	injector-mixer	A device in which gas leaving an injector entrains and mixes with another gas which is at a lower pressure.
10 062	open injector-mixer bunsen-type mixer	An injector-mixer where the additional gas is drawn in from the atmosphere.
10 063	closed injector-mixer	An injector-mixer that is closed to the atmosphere, the entrained gas being drawn up through a tube connected to the unit.
10 064	cone	The more luminous part of a flame, which is adjacent to the nozzle orifice.
10 065	feather	The carbon-rich zone, visible in a flame, extending around and beyond the cone when there is an excess of carbonaceous gas.

No.	Term	Definition
10 066	gas envelope	The gas surrounding the inner cone of an oxy-fuel gas flame.
10 067	threaded hose connection	A 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.
10 068	hose coupling nut union nut: <i>deprecated</i>	A nut used for securing the hose coupling nipple to a threaded hose connection or to a hose coupler. (See note to term 10 067.)
10 069	hose coupling nipple	A 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 10 067.)
10 070	fitted hose	A length of hose at each end of which is a hose coupling nipple and a hose coupling nut.
10 071	hose coupler	A component, consisting of a hexagonal centre portion with threaded ends, for connecting two lengths of fitted hose. (See note to term 10 067.)
10 072	flame snap-out	Unintentional extinction of the flame outside the nozzle orifice.
10 073	flashback	Retrogression of the flame beyond the blowpipe body into the hose, with possible subsequent explosion.
10 074	backfire	Retrogression of the flame into the blowpipe neck or body with rapid self-extinction.
10 075	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.
10 076	gas economizer	An auxiliary device designed for temporarily cutting off the supply of gas to the welding equipment, except the supply to a pilot jet where fitted.

No.	Term	Definition
10 077	pressure regulator gas regulator	A device for attachment to a gas cylinder or pipeline for reducing and regulating the gas pressure to the working pressure required.
10 078	two-stage regulator	A gas regulator in which the gas pressure is reduced to the working pressure in two stages.
10 079	multi-stage regulator	A gas regulator in which the gas pressure is reduced to the working pressure in more than one stage.
10 080	flashback arrester	A safety device fitted in a fuel gas system to prevent any flashback reaching the fuel gas pipeline or supply.
10 081	hydraulic back pressure valve	A 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.
10 082	residual welding stress	Stress remaining in a metal part or structure as a result of welding.
10 083	flame normalizing	Normalizing carried out by direct flame heating.
10 084	pulse	A unidirectional flow of current of either polarity of brief duration.
10 085	pulse time	The duration of a pulse.
10 086	interpulse time	The period of time between successive pulses during the making of a single weld.
10 087	welding cycle time	The period required to complete a welding cycle.
10 088	weld timer	A device that controls only the weld time.
10 089	rectifier converter	A device that converts single or multiphase power from the frequency of the power supply to unidirectional current.
10 090	stored-energy welding	A 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.

No.	Term	Definition
10 091	welding primer weldable primer: <i>deprecated</i>	A film-forming material that is applied to an unpainted 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.
10 092	burnt weld	A weld in which the weld metal has been grossly overheated causing excessive oxidizing thereby reducing the strength of the joint.
10 093	weldability	The ease with which a material or materials can be welded to give an acceptable joint.
10 094	plasma arc	A 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.
10 095	plasma jet	A jet or plasma formed by a non-transferred arc and expelled through an orifice at high velocity by gas pressure.
10 096	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. The cladding material may be applied as powder or as filler wire that is fused to the parent metal.
10 097	nozzle tip: <i>deprecated</i>	The generally detachable part of a blowpipe from which gas or gases emerge.
10 098	blowpipe head	The part of a blowpipe to which a nozzle is fitted.
10 099	blowpipe shank	The part of a blowpipe that is normally held or gripped, to which are fixed the valves and threaded hose connections.
10 100	high pressure blowpipe	A blowpipe in which the pressure of both the fuel gas and the oxygen, measured immediately before the point of mixing, is greater than the pressure of the mixed gases.
10 101	low pressure blowpipe	A blowpipe in which one of the gas pressures, measured immediately before the point of mixing, is lower than the pressure of the mixed gases measured directly down the stream between the mixer and the nozzle entry.

No.	Term	Definition
10 102	head mixing blowpipe	A blowpipe with a mixer or injector-mixer in the head.
10 103	nozzle mixing blowpipe	A blowpipe with a nozzle that contains a mixer or an injector-mixer.
10 104	combined blowpipe combined outfit: <i>deprecated</i> combined set: <i>deprecated</i>	A blowpipe that, when fitted with the appropriate attachments, can be used for welding, cutting, heating or flame cleaning.
10 105	non-return valve	A valve that prevents the passage of gas in the opposite direction to the normal flow.
10 106	harsh flame	A flame in which the velocity of the gases is higher than normal.
10 107	soft flame	A flame in which the velocity of the gases is lower than normal.
10 108	dissolved acetylene	Acetylene made stable under pressure by being dissolved in a liquid, e.g. acetone.
10 109	welding consumables	All materials used up during the making of a weld.
10 110	welding equipment	Items of welding plant and accessories used to make a weld.
10 111	welding accessories	All items of welding equipment associated with welding, other than welding plant and welding consumables.
10 112	mechanized welding	Welding in which the welding parameters are controlled mechanically or electronically and may be manually varied during welding to maintain the required welding conditions.
10 113	groove weld	A weld in a preparation made to receive weld metal.
10 114	layer	A stratum of weld metal consisting of one or more runs.
10 115	building-up	The deposition of metal on a surface until required dimensions are obtained.

No.	Term	Definition
10 116	surfacing	The deposition of metal on a surface to provide a layer giving properties different from those of the parent metal.
10 117	joint preparation weld preparation	A preparation for making a connection where the individual components, suitably prepared and assembled, are joined by welding or brazing.
10 118	joint	A connection where the individual components, suitably prepared and assembled, are joined by welding or brazing.
10 119	burn-off rate	1) In friction welding. The rate of shortening of the components during application of the friction force. 2) In arc welding. The linear rate of consumption of a consumable electrode.
10 120	gap air gap	1) In fusion welding. The minimum distance at any cross section between edges, ends or surfaces to be joined. 2) In magnetically-impelled arc butt welding. The space between component surfaces across which the arc is maintained during the heating (arcing) period.
10 121	roll welding	1) In forge welding. Welding in which the forging pressure is progressively applied by mechanically operated rolls after heating. 2) In fusion welding. A method of manipulation by rotating or rolling pipes or pipe assemblies so that all welding is carried out in or near the flat position.
10 122	robot	A programmable, multi-function manipulator.
10 123	robotic welding	Automatic welding using a robot that can be preprogrammed to different welding paths and fabrication geometries.
10 124	manipulation	The operation of grasping and moving an object.
10 125	manipulator positioner	A mechanism with the necessary degree of freedom for the purpose of gripping and moving an object.

No.	Term	Definition
10 126	adaptive control system feedback control system	A control method in which control parameters are continuously and automatically adjusted in response to measured process variables to achieve the specified performance.
10 127	joint recognition	A 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.
10 128	weld recognition weld feature recognition	A 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.
10 129	joint tracking seam tracking	A 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.
10 130	forehand welding	A welding technique in which the welding torch or gun is pointed in the direction of welding.
10 131	backhand welding	A 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	faying surface interface: <i>deprecated</i>	A surface of one component that is intended to be in contact with a surface of another component to form a joint.
21 002	interface	The 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	upsetting	The operation of locally increasing the cross-sectional area of a workpiece by the application of a longitudinal force.
21 005	upset metal upset	Parent metal proud of the normal surfaces of the work as a result of forging or pressing.
21 006	upset allowance	The length allowed for the total shortening of both components due to upsetting.
21 007	upset speed	The rate of movement of the moving workpiece during upsetting.
21 008	welding cycle	The succession of operations effected by the machine for the making of a weld and the return to the initial position.
21 009	pressure contact area	The initial surface contact area of the components through which force is transmitted.
21 010	forward force^a	The force applied to the movable head of a welding machine in the direction necessary to make a weld.
21 011	initial force^a	The first steady or peak force applied normal to the interface, during the welding cycle.
21 012	welding force^a welding load: <i>deprecated</i>	The force, at the abutting surfaces of a workpiece, used to make a weld.
21 013	upset force^a	The force producing or tending to produce upset metal.
21 014	post-weld upset force^a	The force required to reduce the workpiece to its correct length after welding.

^a Force is sometimes incorrectly referred to as pressure. See terms 21 016 to 21 021.

No.	Term	Definition
21 015	post-heating force^a	The force applied by the electrodes to the work during the time post-heating current is flowing.
21 016	forward pressure	The pressure (force per unit area) resulting from the forward force.
21 017	initial pressure	The pressure (force per unit area) resulting from the initial force.
21 018	welding pressure	The pressure (force per unit area) resulting from the welding force.
21 019	upset pressure	The pressure (force per unit area) resulting from the upset force.
21 020	post-weld upset pressure	The pressure (force per unit area) resulting from the post-weld upset force.
21 021	post-heating pressure	The pressure (force per unit area) resulting from the post-heating force.
21 022	overhang	The 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.
21 023	digital timer	Apparatus for controlling intervals of time by means of counting, to a preset number, pulses which have a constant rate of repetition.
21 024	analogue timer	Apparatus for controlling intervals of time that relies upon any time dependent physical change.
21 025	sequence timer	Apparatus comprising a group of timers for controlling various functions in a welding cycle in a predetermined sequence.
21 026	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.
21 027	upset length	The total actual shortening of both components due to the forging action in the making of a weld.

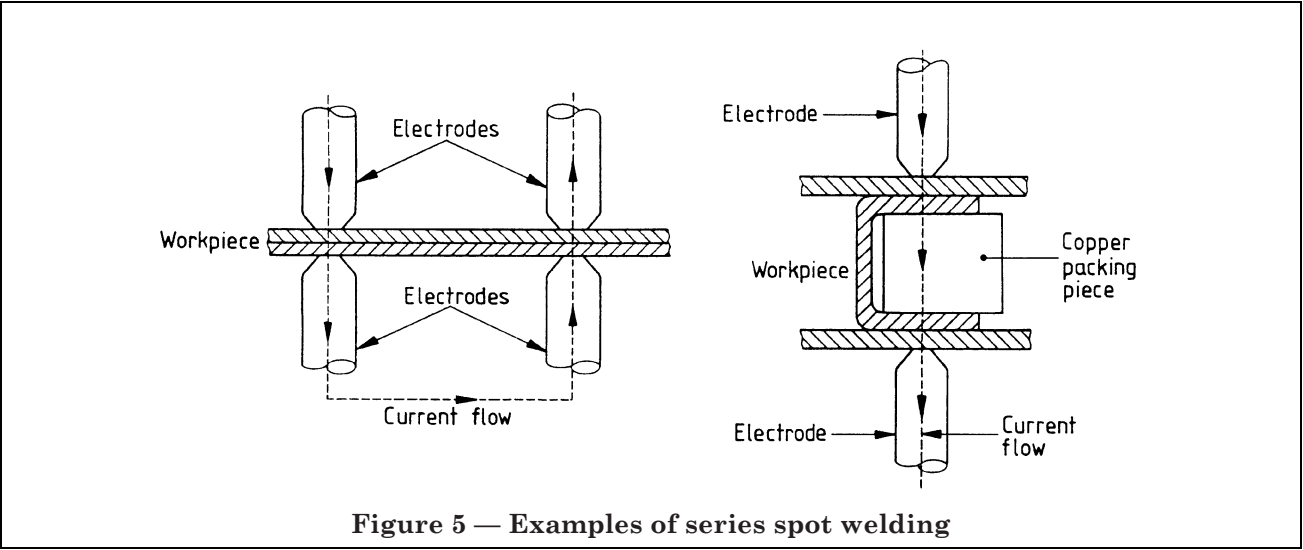
^a Force is sometimes incorrectly referred to as pressure. See terms 21 016 to 21 021.

No.	Term	Definition
21 028	total loss	In pressure, resistance butt, flash, friction or magnetically impelled arc butt welding, the total amount of shortening of both components due to all the operations that are actually used in the making of a weld.
21 029	forging force forge force	The force applied normal to the faying surfaces to complete the weld.
21 030	forging pressure forge pressure	The pressure (force per unit area) resulting from the forging force.
21 031	forging time forge time	The duration of application of the forging force.
21 032	forge welding fire welding	Any welding process in which the weld is made by hammering or some other impulsive force while the surfaces to be united are plastic.

Subsection 22. Terms relating only to resistance welding

22 001	resistance welding	Welding in which, at some stage in the process, force is applied to surfaces in contact and in which the heat for welding is produced by the passage of electric current through the electrical resistance at, and adjacent to, these surfaces.
22 002	resistance butt welding slow butt welding: <i>deprecated</i> upset butt welding: <i>deprecated</i>	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: <i>deprecated</i>	Resistance butt welding in which the components are progressively advanced towards each other while the current, confined to localized points of contact, causes expulsion of molten metal. When welding temperature is reached, upset force is applied.
22 004	straight flash welding	A flash welding technique in which flashing starts as soon as the workpieces are brought into contact and is maintained until upsetting takes place.
22 005	flash welding with preheating	A flash welding technique in which preheating current is applied to the workpieces to facilitate the onset of flashing.

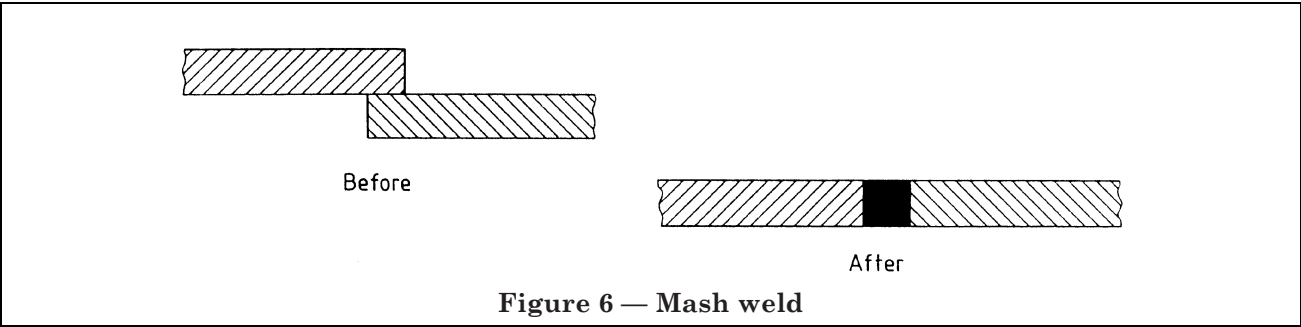
No.	Term	Definition
22 006	spot welding	Resistance welding in which a weld is produced at a spot in the work-piece between electrodes, the weld being of approximately the same area as the electrode tips, or as the smaller of tips of differing size. Force is applied to the spot, usually through the electrodes, continuously throughout the process.
22 007	stitch welding	Spot welding in which successive welds overlap.
22 008	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.
22 009	series spot welding	Spot welding in which two or more welds are made simultaneously in electrical series. (See Figure 5.)



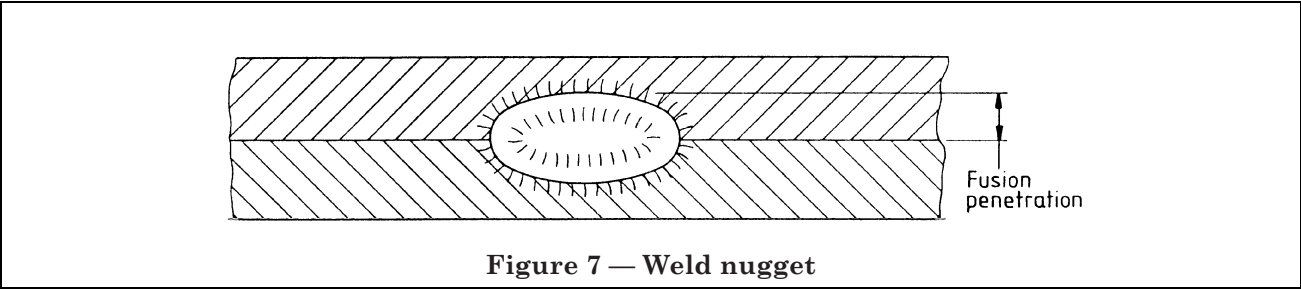
22 010	roller spot welding	Spot welding in which force is applied continuously and current intermittently to produce a line of separate spot welds, the workpieces being between two electrode wheels or between an electrode wheel and an electrode bar. The wheels apply the force and current and rotate continuously while the line of welds is being made.
22 011	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.

No.	Term	Definition
22 012	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.
22 013	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.
22 014	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.
22 015	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.
22 016	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.
22 017	projection welding	Resistance welding in which the localizing of force and current to make the weld or welds is obtained by the shape of the components or by the use of a projection or projections raised on one or more of the faying surfaces. The projections collapse during welding.
22 018	resistance stud welding	Stud welding using projection welding. (See terms 10 031 and 22 017).
22 019	pulsation welding woodpecker welding: <i>deprecated</i>	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.
22 020	percussion welding	Resistance welding in which the workpieces are brought together with a rapidly increasing force. A current of short duration is supplied from a capacitor or the like either before the components touch or while the welding force is very low.

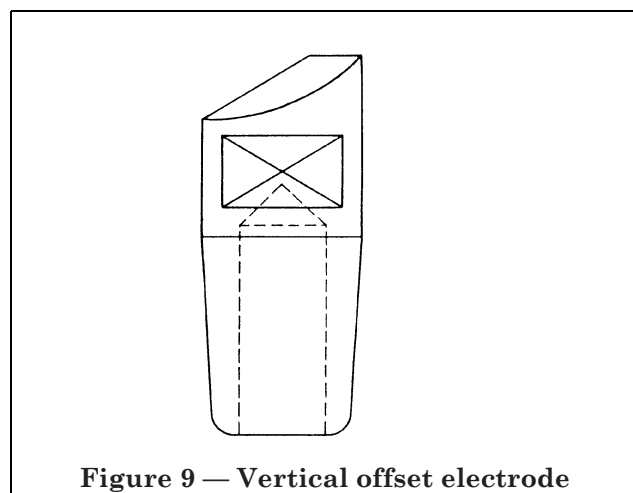
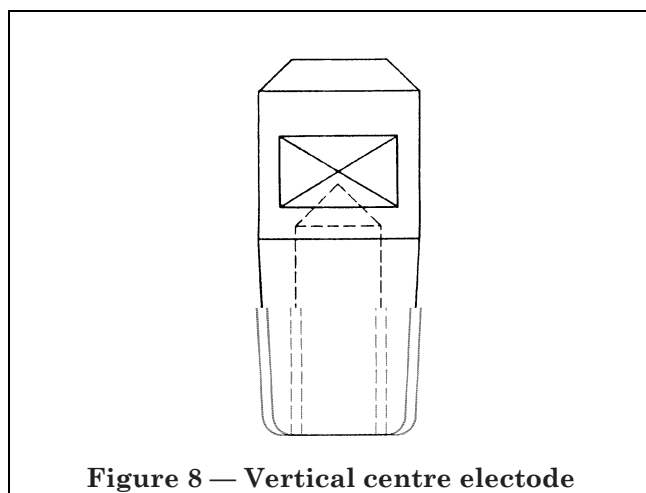
No.	Term	Definition
22 021	half-cycle welding	Spot, projection or percussion welding in which the welding operation is completed in a whole or part of any one half cycle of the a.c. supply.
22 022	HF resistance welding	Resistance welding in which an alternating electric current of at least 10 kHz is 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.
22 023	mash weld	A 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 6.)



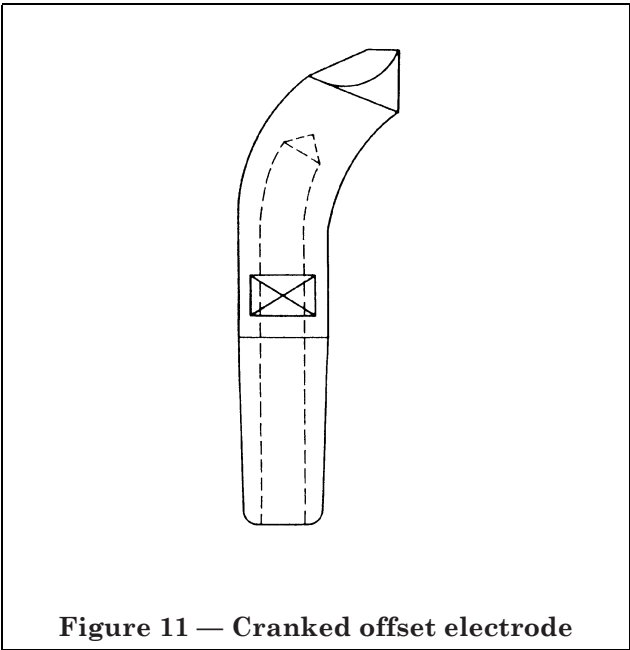
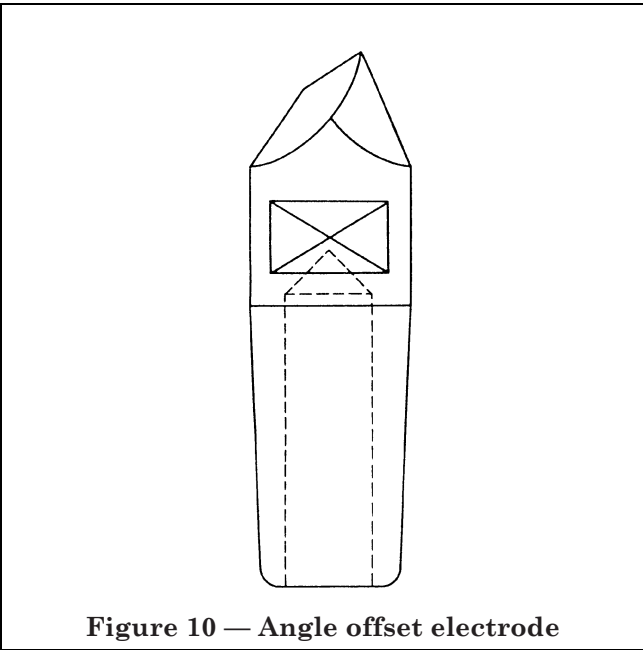
22 024	cross-wire weld	A resistance weld at the point of contact between crossed wires or rods made with pressure applied continuously.
22 025	weld nugget	A zone in a resistance weld where the metal has been melted. (See Figure 7.)



No.	Term	Definition
22 026	resistance welding electrode electrode	A replaceable portion of a resistance welding machine which transmits current, and usually applies force to the workpiece. NOTE This should not be confused with term 32 027.
22 027	electrode tip	The surface of an electrode for spot or stitch welding intended to make contact with the workpiece.
22 028	electrode shank	The portion of an electrode for spot or stitch welding intended to be held by, and to make electrical contact with, an electrode holder.
22 029	electrode wheel	A rotatable electrode of disc form.
22 030	vertical electrode	An electrode for spot or stitch welding in which the electrode tip is normal to the axis of the electrode shank.
22 031	angle electrode inclined electrode	An electrode for spot or stitch welding in which the electrode tip is not normal to the axis of the electrode shank.
22 032	offset electrode	An electrode for spot or stitch welding in which the electrode tip is not concentric with the axis of the electrode shank.
22 033	vertical centre electrode straight electrode	A vertical electrode where the electrode tip is concentric with the axis of the electrode shank. (See Figure 8.)
22 034	vertical offset electrode	A vertical electrode where the electrode tip is not concentric with the axis of the electrode shank. (See Figure 9.)



No.	Term	Definition
22 035	angle offset electrode	An angle electrode in which the electrode tip is not concentric with the axis of the electrode shank. (See Figure 10.)
22 036	cranked offset electrode cranked electrode	An offset electrode in which the centreline of the electrode is not straight. (See Figure 11.)



22 037	pad electrode flat electrode	An electrode having an area of contact with the work that is much larger than the weld required.
22 038	tread	The peripheral surface of an electrode wheel.
22 039	electrode pick-up	Contamination of the resistance welding electrode by metal or scale from the surface of the workpiece.
22 040	surface pick-up	Contamination of the surface of a resistance weld by particles of the electrode.
22 041	edge distance	The distance between the centre of a weld and the nearest edge of the workpiece.
22 042	welding die die	A device for locating the components of a workpiece in a resistance welding machine and for transmitting force and welding current to them.
22 043	insert	A 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.

No.	Term	Definition
22 044	platen	The part of a resistance welding machine on which welding dies or bolsters can be mounted and which conveys force and welding current to them.
22 045	bolster	An electrode holder for mounting on a platen.
22 046	arm	A 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.
22 047	fin	An extrusion of metal extending outward beyond the upset metal in the form of a fin.
22 048	flash	The metal expelled as molten particles during flash welding.
22 049	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.
22 050	flashing allowance	The length allowed for the total shortening of both components due to flashing, in preparation for flash welding.
22 051	weld contact area interface: <i>deprecated</i>	The area through which welding current passes from one component to another during resistance welding.
22 052	electrode contact area clamp contact area die contact area	The area through which current passes from an electrode or a clamp to the workpiece.
22 053	backward force^a back pressure: <i>deprecated</i>	The force tending to separate the electrodes.
22 054	electrode force^a	The force transmitted by the electrodes to the workpiece.
22 055	backward pressure back pressure: <i>deprecated</i>	The pressure (force per unit area) resulting from the backward force.
22 056	electrode pressure	The pressure (force per unit of electrode contact area) resulting from the electrode force.
22 057	hand-operated welding machine	A welding machine in which the mechanical force is applied by hand.
22 058	foot-operated welding machine pedal-operated welding machine	A welding machine in which the mechanical force is applied by means of a pedal.

^a Force is sometimes incorrectly referred to as pressure. See terms 22 055 and 22 056.

No.	Term	Definition
22 059	power-operated welding machine	A welding machine in which mechanical force is applied by an inanimate source of power.
22 060	motor-operated welding machine	A welding machine in which the travel of the electrode is provided and the mechanical force is applied by means of a motor-driven mechanism.
22 061	portable spot-welding machine	A 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.
22 062	plier spot-welding machine pincer spot-welding machine	A portable spot-welding machine in which force is applied to electrodes by means of a lever system similar to that of pliers.
22 063	capacitor spot-welding machine^a condenser-discharge spot-welding machine	A 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.
22 064	inductor spot-welding machine^a induction spot-welding machine	A 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.
22 065	battery spot-welding machine^a	A spot-welding machine in which a battery is used to provide the welding current.
22 066	weld slug	The 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.
22 067	preheat time	The duration of preheating current. In flash welding it is the time between the first passage of current and the start of continuous flashing.
22 068	squeeze time^b	The period of time between the normal application of force by the electrodes to the work and the first passage of current. NOTE In timers complying with National Electrical Manufacturers Association specifications, this is the period between the initiating of the welding operation and the first passage of current.

^a These machines are sometimes referred to as “stored-energy machines”.

^b Attention is drawn to Figure 12 to Figure 23 for diagrammatic representations of these terms.

No.	Term	Definition
22 069	flashing time^a	In flash welding, the period of time between the start of continuous flashing and the time when the upset force is applied.
22 070	upset time^a	The duration of upset travel.
22 071	upset current time^a	The duration of current from the commencement of upset travel.
22 072	heat time^a on-time	In pulsation and seam welding, the duration of each successive welding current impulse.
22 073	cool time^a off-time	In pulsation and seam welding, the period of time between two successive heat times in the same welding cycle.
22 074	weld time^a	The total time between the start and finish of welding current during the making of one weld. NOTE A seam weld is considered to be one weld.
22 075	step time^a	In roller spot welding and in step-by-step roller spot welding, the period of time between successive weld times.
22 076	chill time^a quench time	The period of time between the end of welding current and the start of post-heating current.
22 077	post-heat time^a	The duration of flow of post-heating current.
22 078	hold time^a dwell time	The period of time between the cessation of current in a welding cycle and the cessation of electrode force.
22 079	current-off time^a	The period of time between the cessation of current in one welding cycle and the beginning of current in the next.
22 080	pressure-off time^a	In spot, seam and projection welding, the period of time between two successive welding cycles when no electrode force is being applied to the workpiece.
22 081	preheating current	The 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.
22 082	welding current	The current (excluding preheating current) used to bring the workpiece to, and maintain it at, welding temperature.

^a Attention is drawn to Figure 12 to Figure 23 for diagrammatic representations of these terms.

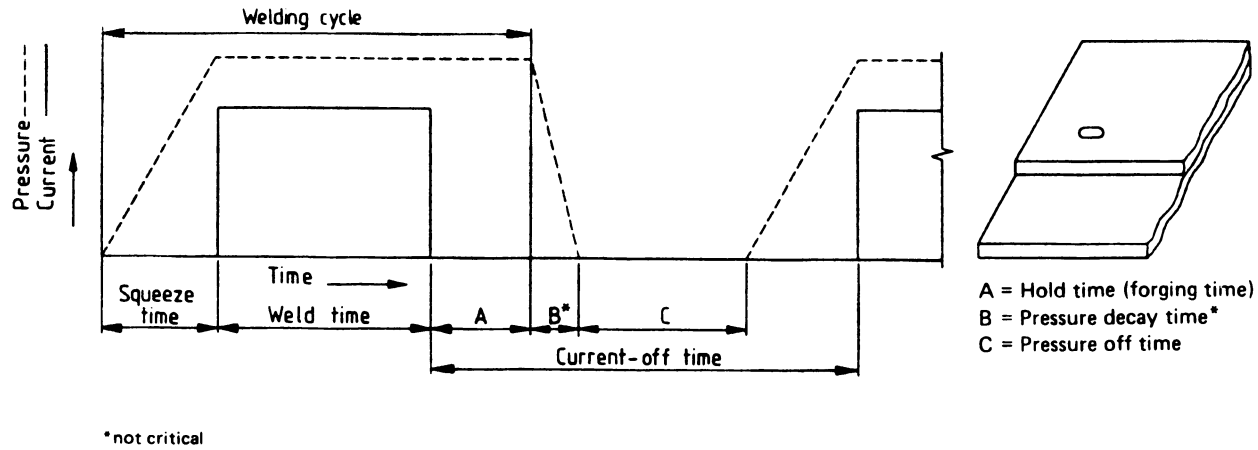


Figure 12 — Time and pressure diagram for simple spot, stitch, or projection welding

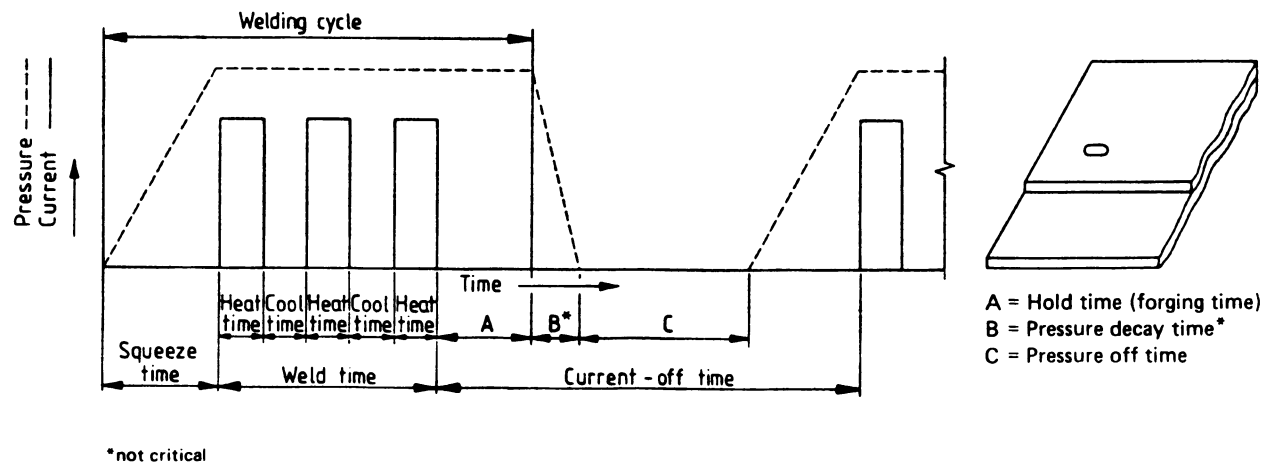


Figure 13 — Time and pressure diagram for pulsation spot or projection welding

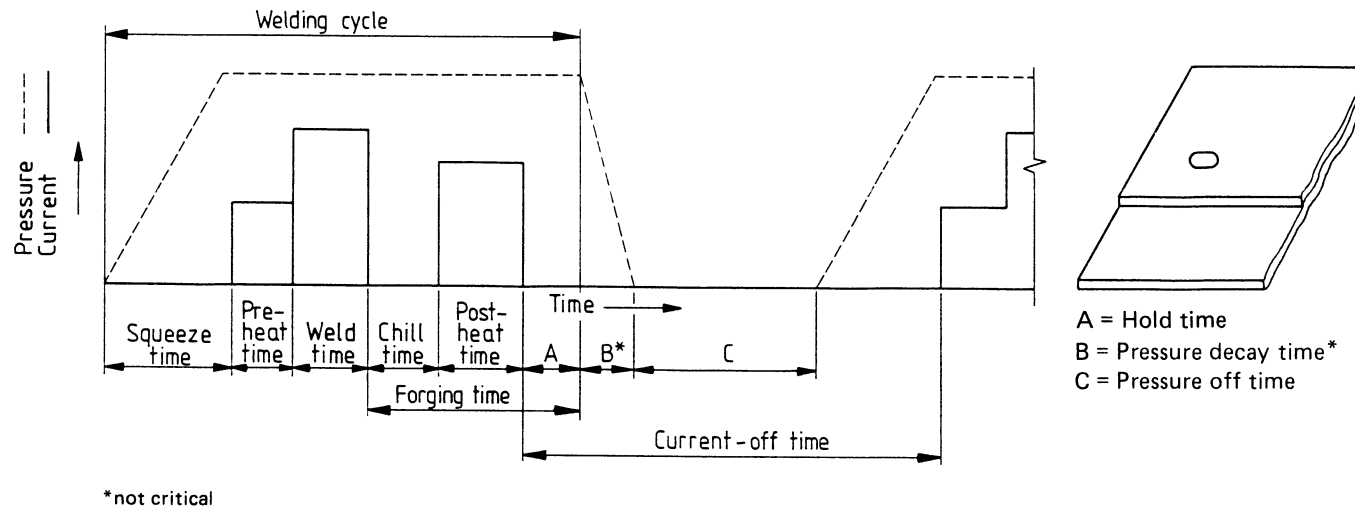


Figure 14 — Time and pressure diagram for spot or projection welding, programme control

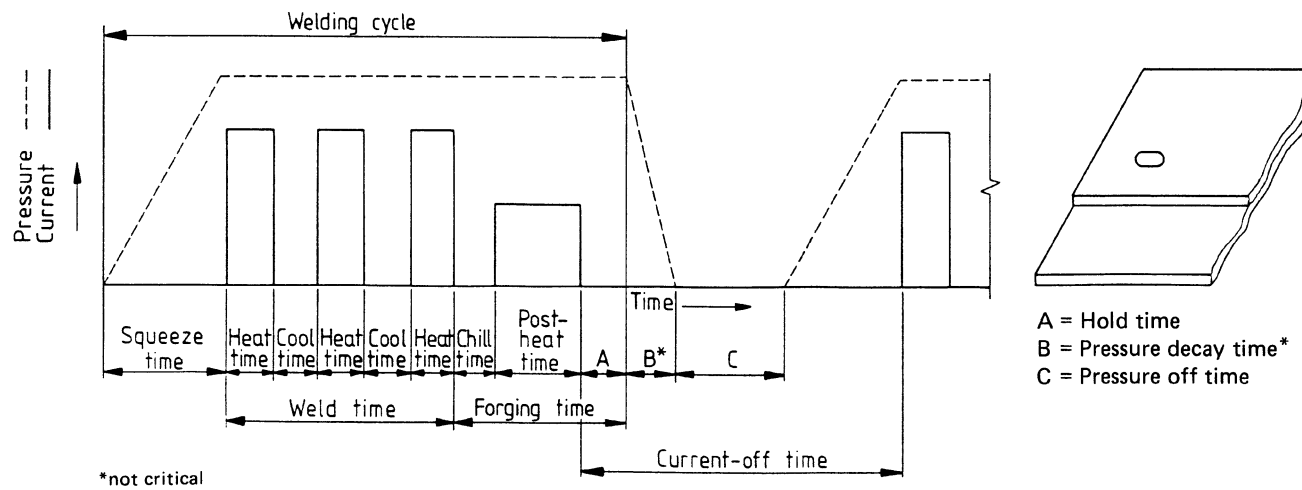


Figure 15 — Time and pressure diagram for pulsation spot or projection welding, programme control

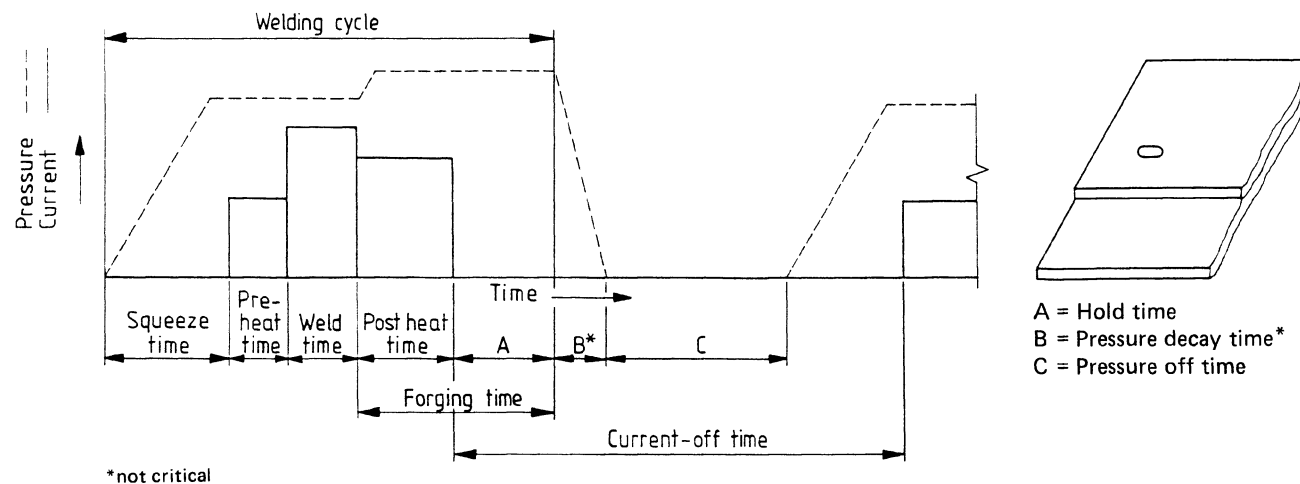


Figure 16 — Time and pressure diagram for spot welding, programme control with dual-pressure cycle

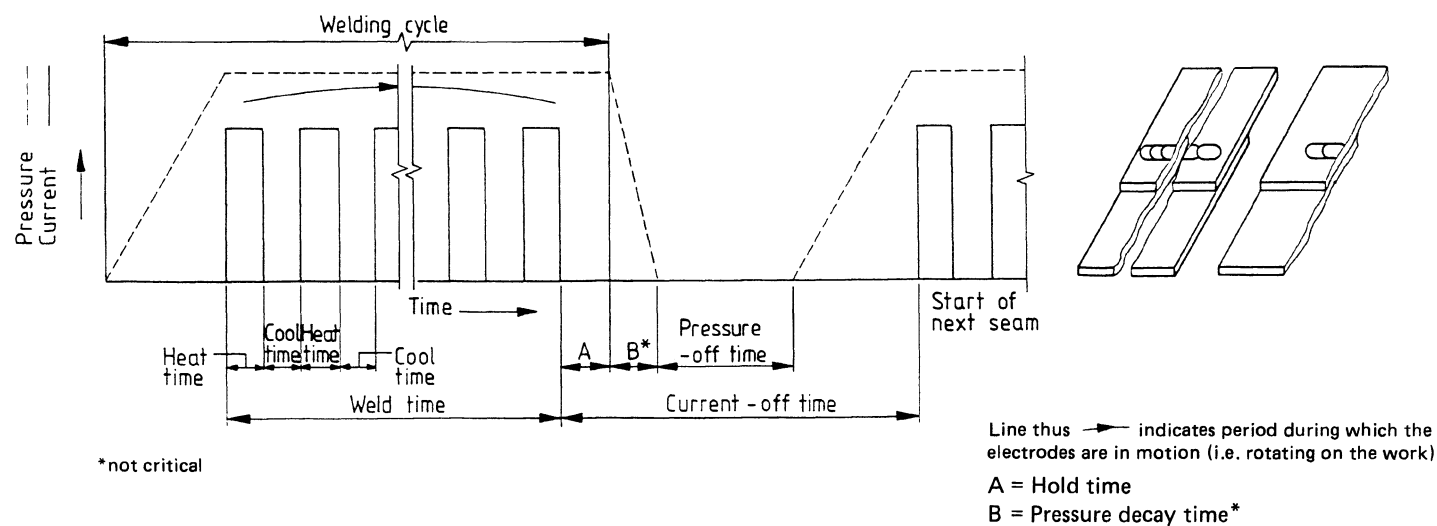


Figure 17 — Time and pressure diagram for seam welding

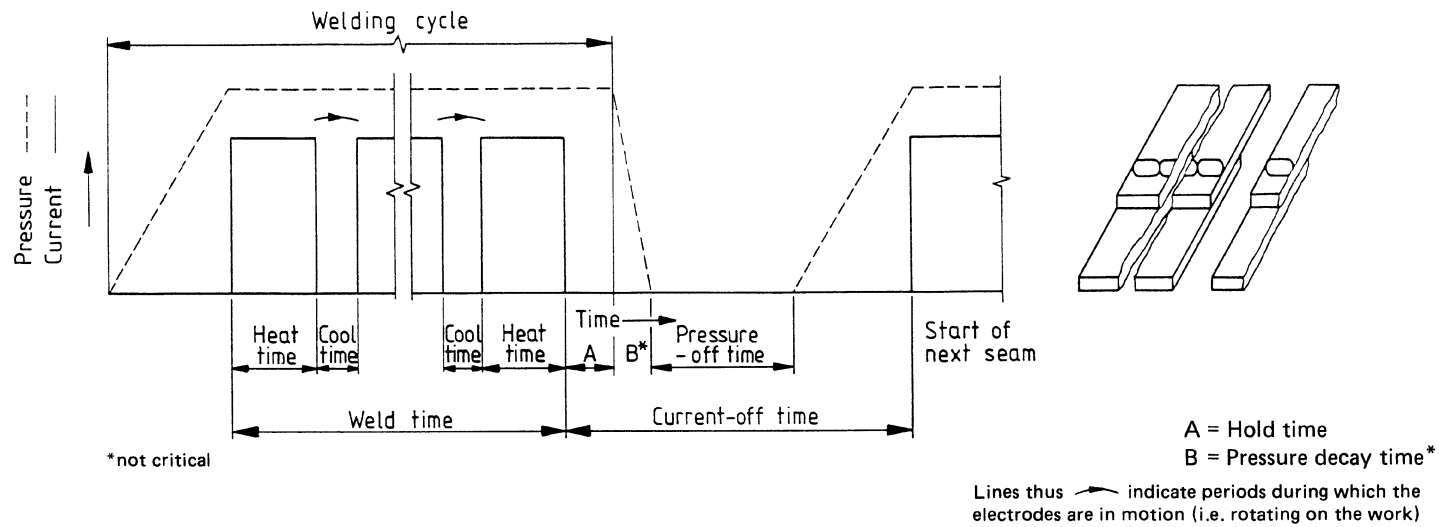


Figure 18 — Time and pressure diagram for step-by-step seam welding

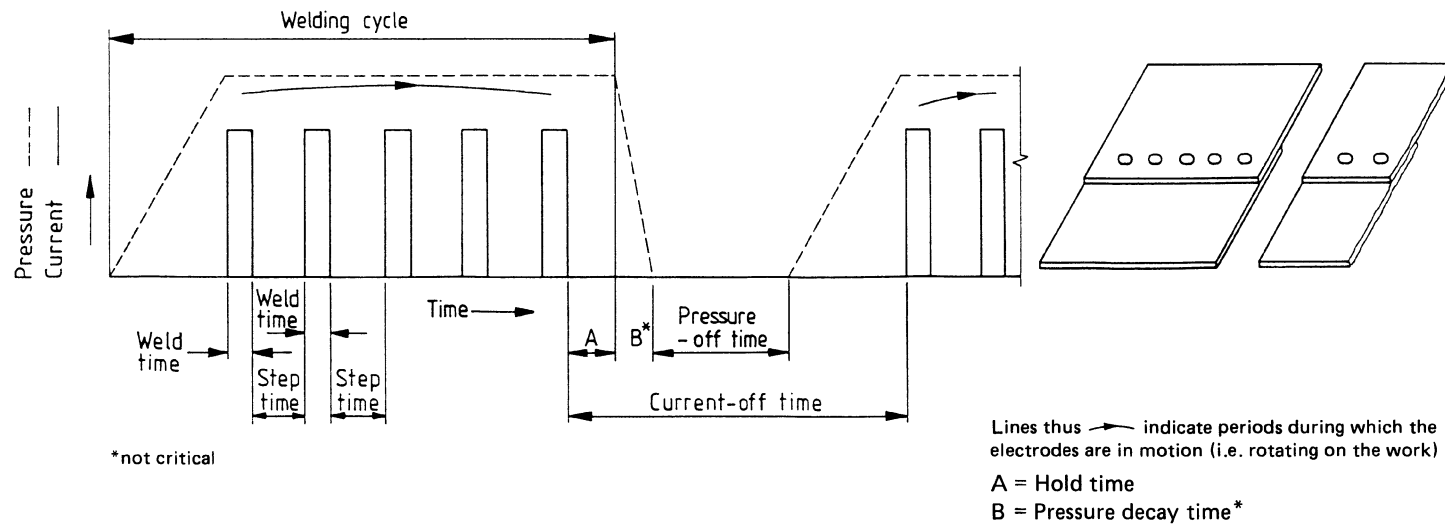


Figure 19 — Time and pressure diagram for roller spot welding

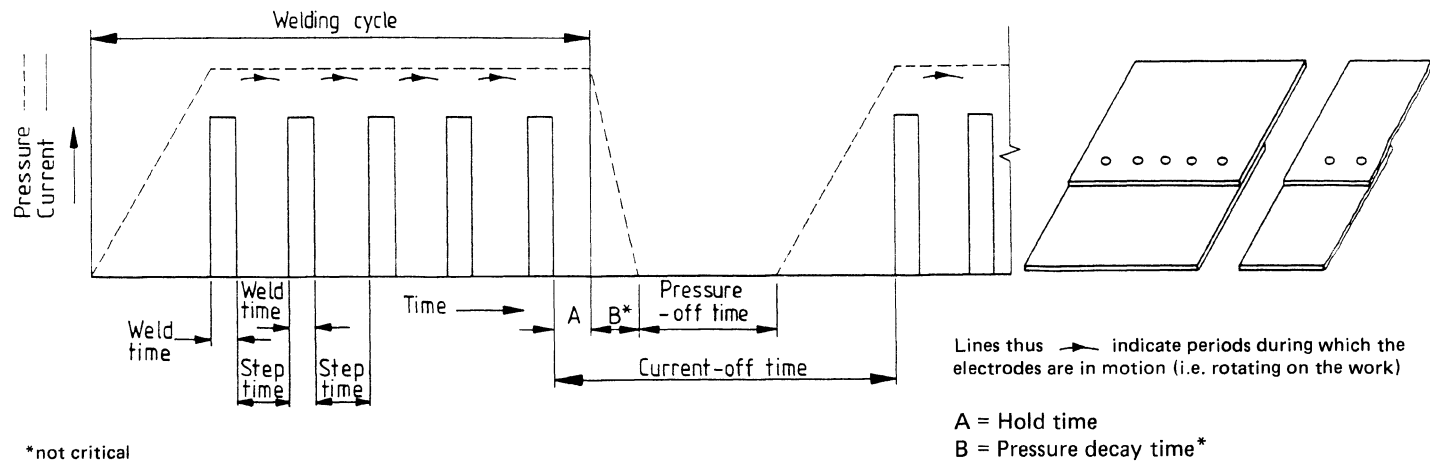


Figure 20 — Time and pressure diagram for step-by-step roller spot welding

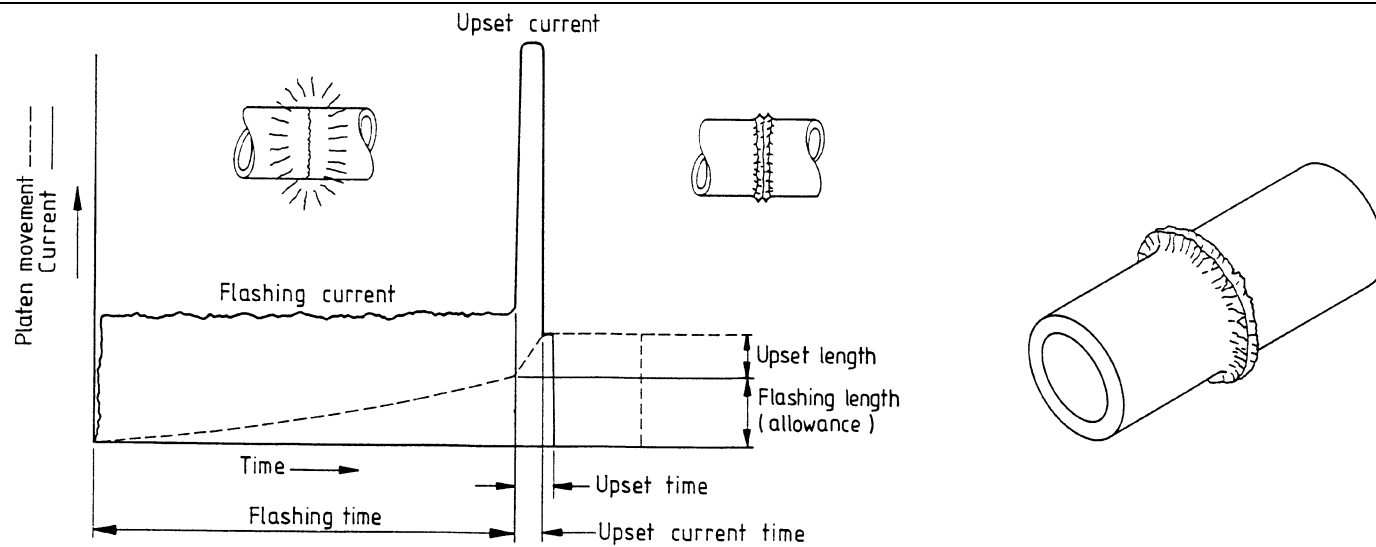
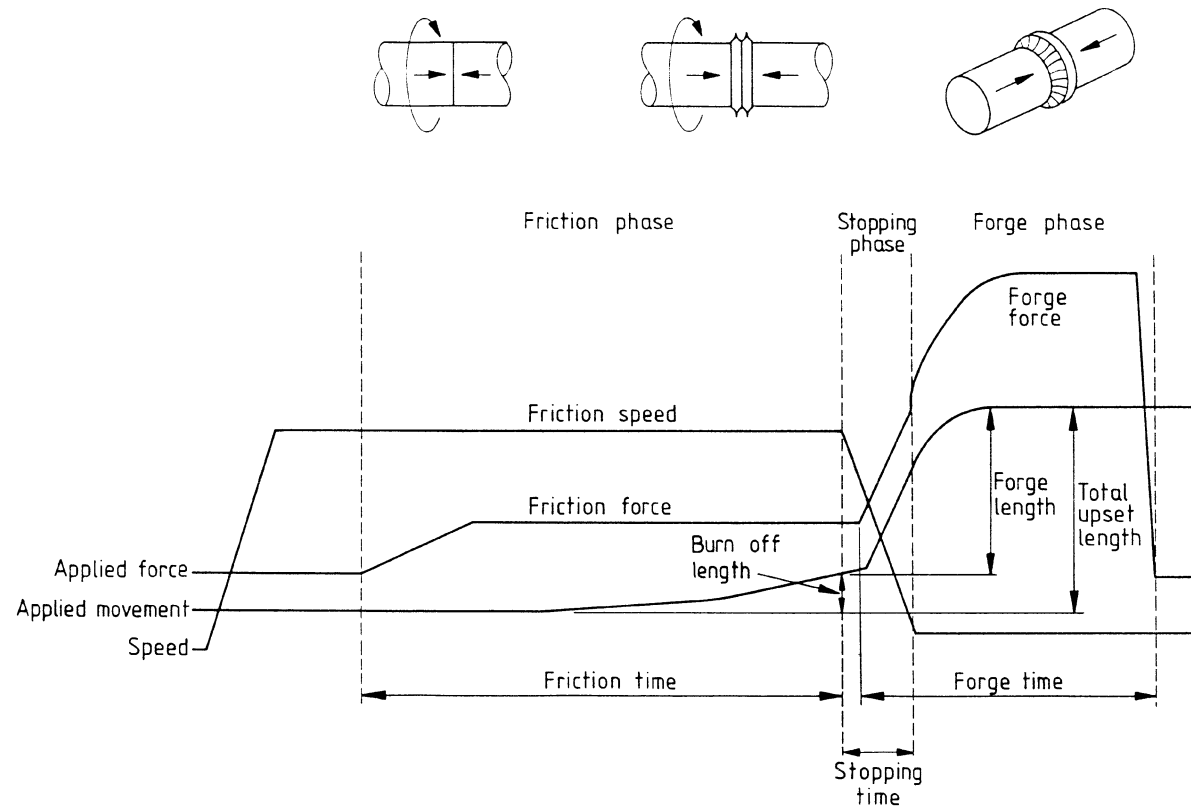
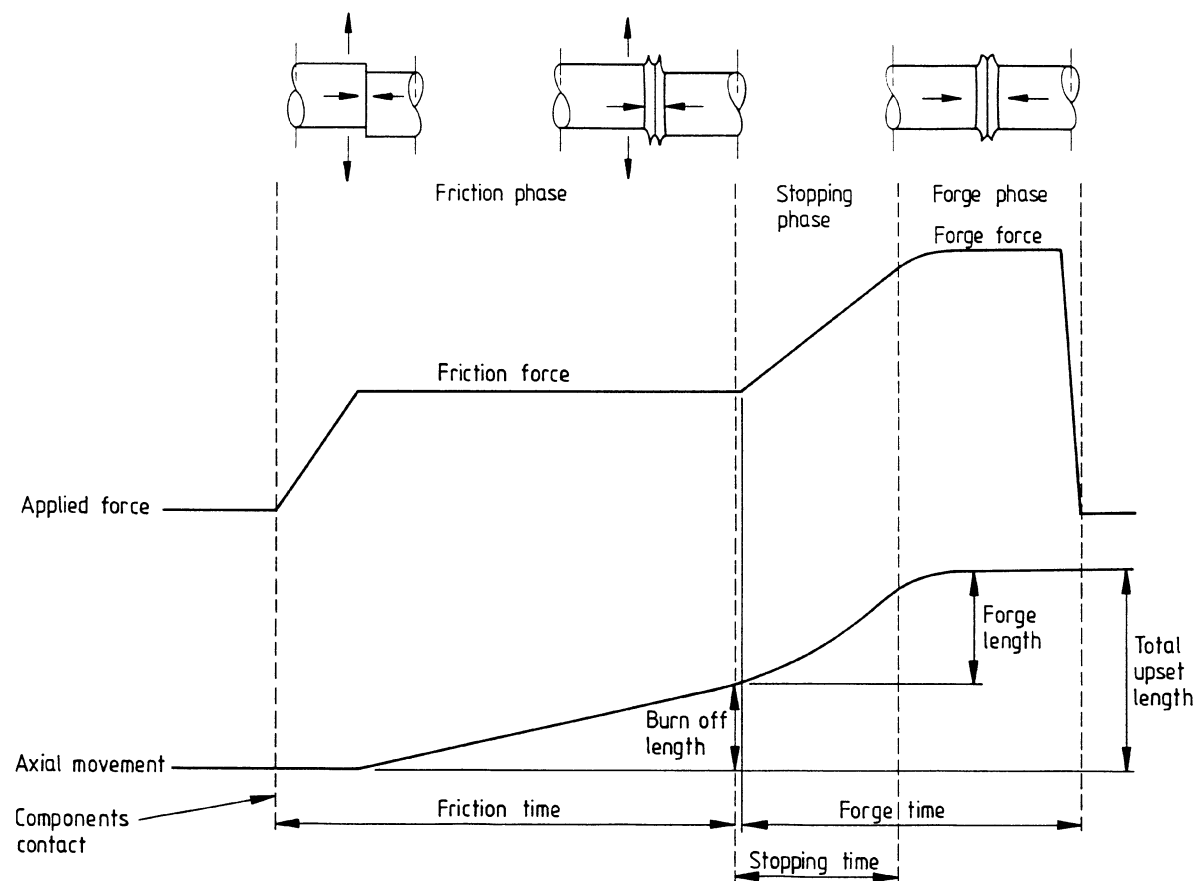


Figure 21 — Time and platen movement diagram for straight flash welding



(a) Rotating movement

Figure 22 — Generalized diagram of speed, applied force, axial movement and time for continuous drive friction welding



(b) Reciprocating movement

Figure 22 — Generalized diagram of speed, applied force, axial movement and time for continuous drive friction welding (concluded)

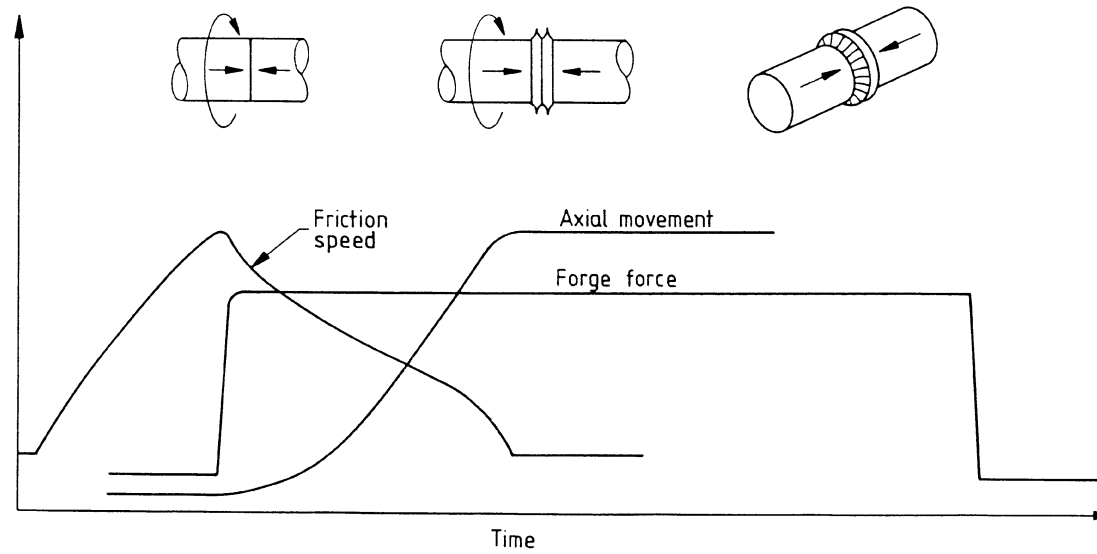


Figure 23 — Generalized diagram of speed, applied force and axial movement with time for stored energy friction welding

No.	Term	Definition
22 083	flashing current	The current flowing during flashing time.
22 084	post-heating current	The current that is passed through a completed weld to heat it, usually for metallurgical reasons.
22 085	dual-pressure cycle	A welding cycle characterized by the application of two different predetermined electrode forces.
22 086	programme control	A method of controlling a predetermined sequence of changes of current and/or force during a welding cycle.
22 087	heat control	A means of smoothly controlling the value of the current flowing through a resistance welding machine.
22 088	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.
22 089	synchronous control	An 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.
22 090	non-synchronous control	A 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.
22 091	phase shift	The alteration of the phase relationship between two a.c. voltages. Generally this is used to control the period of conduction in each half cycle of ignitron or thyristor contactors.
22 092	phase angle firing angle	The 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.
22 093	slope control	The 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 32 065.
22 094	rate of slope	The rate of change of current when using slope control.

No.	Term	Definition
22 095	slope-up	The controlled gradual increase of the current in slope control.
22 096	slope-down	The controlled gradual decrease of the current in slope control.
22 097	slope time	The duration of slope-up or slope-down.
22 098	upset travel	1) In resistance butt welding. The 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. The 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.
22 099	flashing travel	The distance travelled by the platen during flashing in flash welding.
22 100	flashing speed	The rate of travel of the platen during the flashing cycle in flash welding.
22 101	preheating loss	The total loss of length of both components during preheating a flash weld.
22 102	machine stroke	The maximum operational stroke obtainable.
22 103	operational stroke	The distance through which the electrode(s) may travel from rest to the final position during welding.
22 104	throat depth throat	The unobstructed distance in a welding machine from the centreline of the electrodes to the nearest point of obstruction to flat workpieces or sheets.
22 105	throat gap	The minimum unobstructed distance between the arms of a welding machine.
22 106	die opening die gap	In a flash or resistance butt welding machine, the distance between the opposing faces of the two pairs of dies when the machine is set up for welding.
22 107	clamp opening	The distance between the jaws of a clamp in the open position, through which the workpiece would be inserted or withdrawn.