Fusion

Welding

1. Energy source

Classification of Fusion welding based on energy source

Energy source	Types of welding
Chemical	Oxy fuel gas welding, Exothermic welding/ Thermite welding, Reaction brazing/Liquid phase bonding
Radiant energy	Laser beam welding, Electron beam, Infrared welding/ brazing, Imaging arc welding, Microwave welding,
Electric-Perm. electrode arc	Gas tungsten arc welding, plasma arc welding, Carbon arc welding, atomic hydrogen welding, Stud arc welding
Electric-Consumable electrode	Gas metal arc welding, Shielded metal arc welding, Submerged arc welding, Electrogas welding, Electroslag welding, Flux cored arc welding
Electric-Resistance	Resistance spot, resistance seam, projection welding, flash/ upset welding, Percussion, Induction welding

THERMITE WELDING

Class: Fusion Welding
Energy Source: Chemical

THERMITE WELDING (TW)

A welding process producing coalescence of metals by heating them with superheated liquid metal from a chemical reaction between a metal oxide and aluminum, with or without the application of pressure. Filler metal is obtained from the liquid metal. AWS A3.0M/A3.0:2010

THERMITE REACTION

The chemical reaction between metal oxide and aluminum producing superheated molten metal and a slag containing aluminum oxide.

Aluminothermic reactions are exothermic chemical reactions using aluminium as the reducing agent at high temperature. The process is industrially useful for production of alloys of iron.[1] The most prominent example is the thermite reaction between iron oxides and aluminium to produce iron itself:

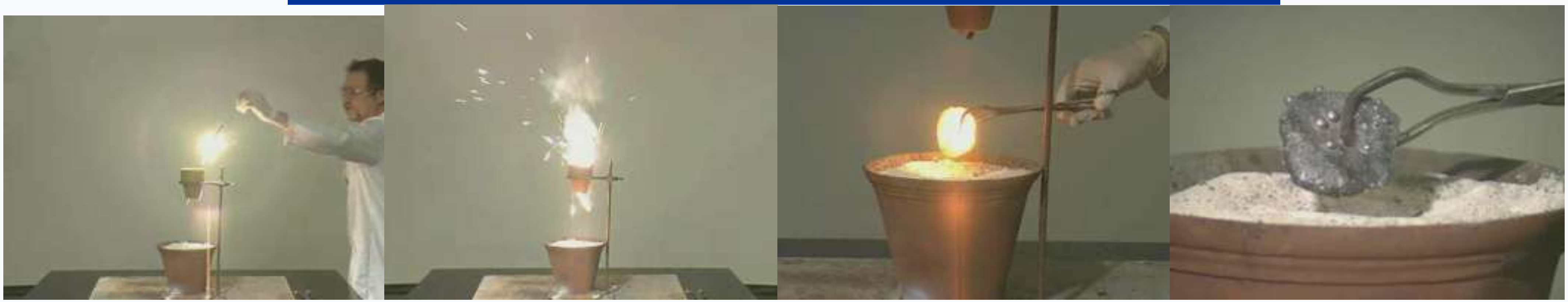
$Fe_2O_3 + 2\ Al \rightarrow 2\ Fe + Al_2O_3$

This specific reaction is however not relevant to the most important application of aluminothermic reactions, the production of ferroalloys. For the production of iron, a cheaper reducing agent, coke, is used instead via the carbothermic reaction.

Aluminothermy started from the experiments of Russian scientist Nikolay Beketov at the University of Kharkiv in Ukraine, 1859

4.С оксидами металлов (алюминотермия).

$$2AL + Fe_2O_3 = AL_2O_3 + 2Fe$$





A thermite mixture using iron (III) oxide

A thermite reaction using iron(III) oxide. The sparks flying outwards are globules of molten iron trailing smoke in their wake.

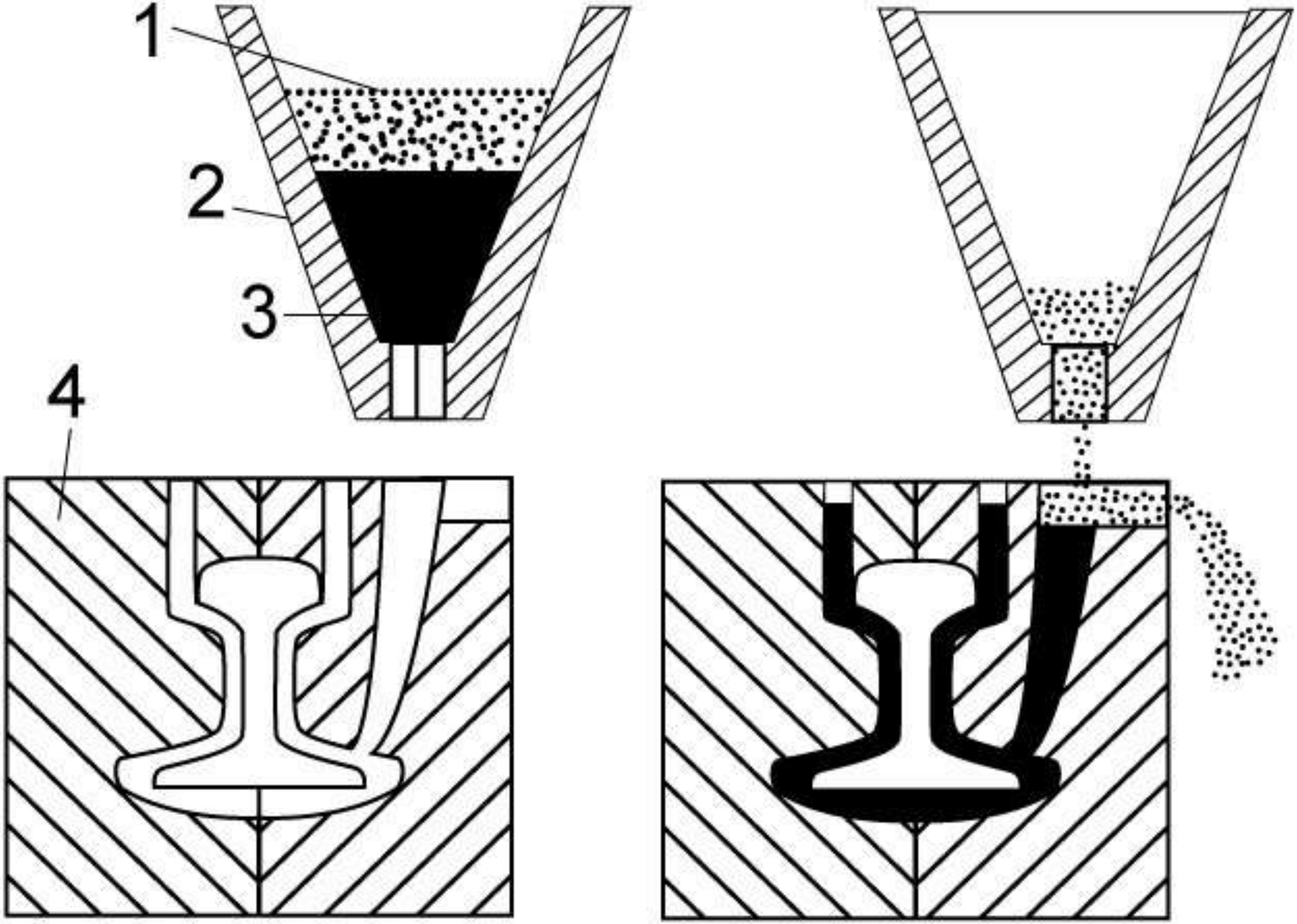
Thermite (/ˈθɜːrmaɪt/)[1] is a pyrotechnic composition of metal powder, which serves as fuel, and metal oxide. When ignited by heat, thermite undergoes an exothermic reduction-oxidation (redox) reaction. Most varieties are not explosive, but can create brief bursts of heat and high temperature in a small area. Its form of action is similar to that of other fuel-oxidizer mixtures, such as black powder.

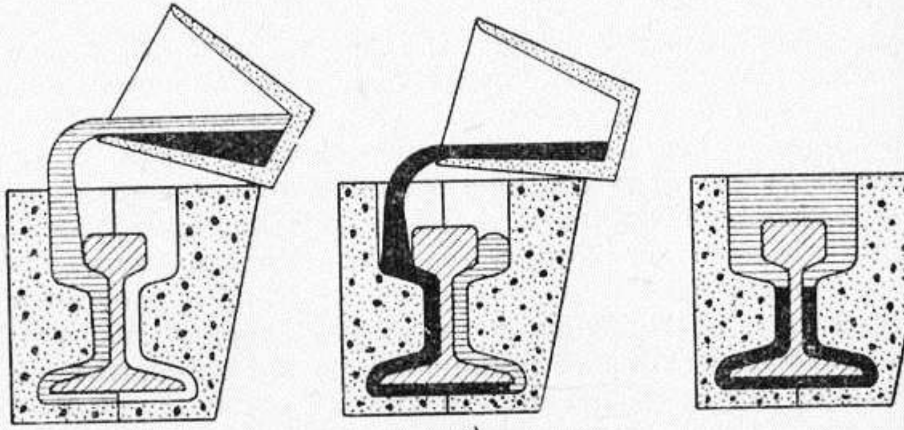
Thermites have diverse compositions. Fuels include aluminium, magnesium, titanium, zinc, silicon, and boron. Aluminium is common because of its high boiling point and low cost. Oxidizers include bismuth(III) oxide, boron(III) oxide, silicon(IV) oxide, chromium(III) oxide, manganese(IV) oxide, iron(III) oxide, iron(II,III) oxide, copper(II) oxide, and lead(II,IV) oxide.

In the following example, elemental aluminium reduces the oxide of another metal, in this common example iron oxide, because aluminium forms stronger and more stable bonds with oxygen than iron:

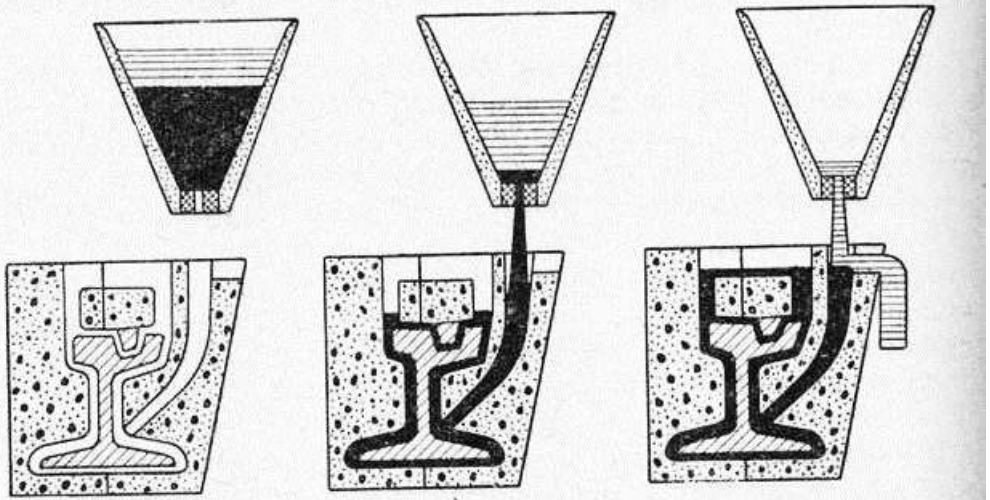
$$Fe_2O_3 + 2\ Al \rightarrow 2\ Fe + Al_2O_3$$

An exothermic weld has higher mechanical strength than other forms of weld, and excellent corrosion resistance[7] It is also highly stable when subject to repeated short-circuit pulses, and does not suffer from increased electrical resistance over the lifetime of the installation. However, the process is costly relative to other welding processes, requires a supply of replaceable moulds, suffers from a lack of repeatability, and can be impeded by wet conditions or bad weather (when performed outdoors).Exothermic welding is usually used for welding copper conductors but is suitable for welding a wide range of metals, including stainless steel, cast iron, common steel, brass, bronze, and Monel.[4] It is especially useful for joining dissimilar metals.[5] The process is marketed under a variety of names such as APLIWELD (in tablet form), American Rail Weld, Harger ULTRASHOT, ERICO CADWELD, Quikweld, Tectoweld, Ultraweld, Techweld, TerraWeld, Thermoweld, Ardo Weld, AmiableWeld, AIWeld, FurseWeld and Kumwell.[4]

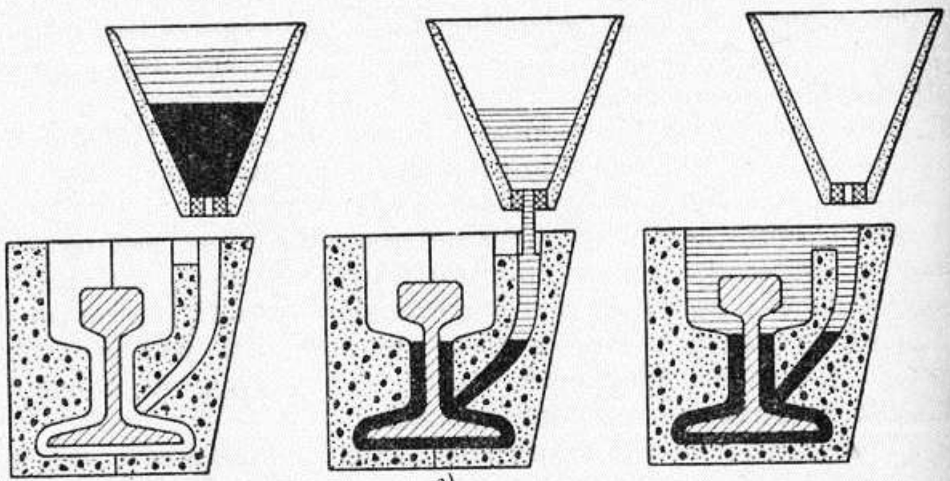

1
2
3
4



а)

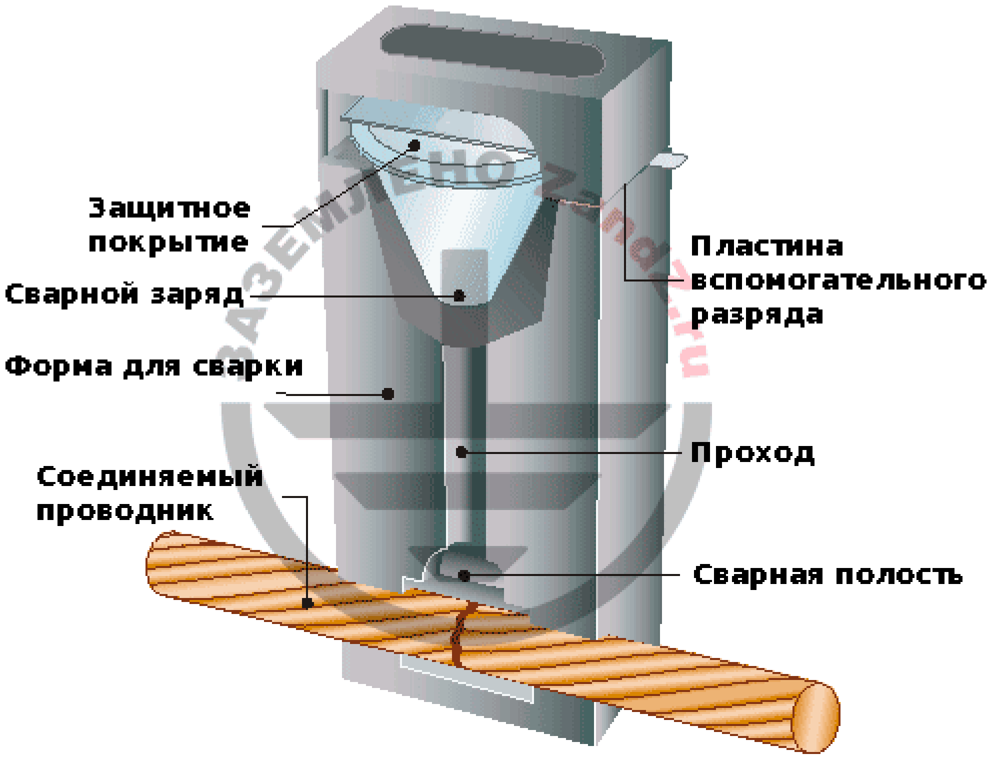


б)



в)

Polymeric Cover
CADWELD PLUS Package
Graphite Mold
Conductor
Igniter Strip
Tap Hole
Weld Cavity



Защитное покрытие
Сварной заряд
Форма для сварки
Соединяемый проводник
Пластина вспомогательного разряда
Проход
Сварная полость

ИЗГОТОВЛЕНИЕ СВАРКИ CADWELD®
Крышка формы
Стартовый запал
Термитная смесь
Жестяной пыж
Графитовая форма
Сквозное отверстие
Сварная полость
Проводник
Проводник

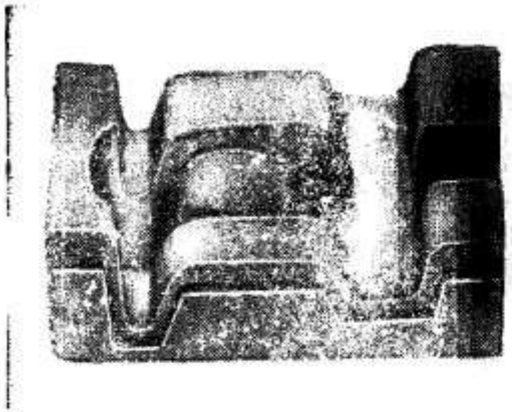
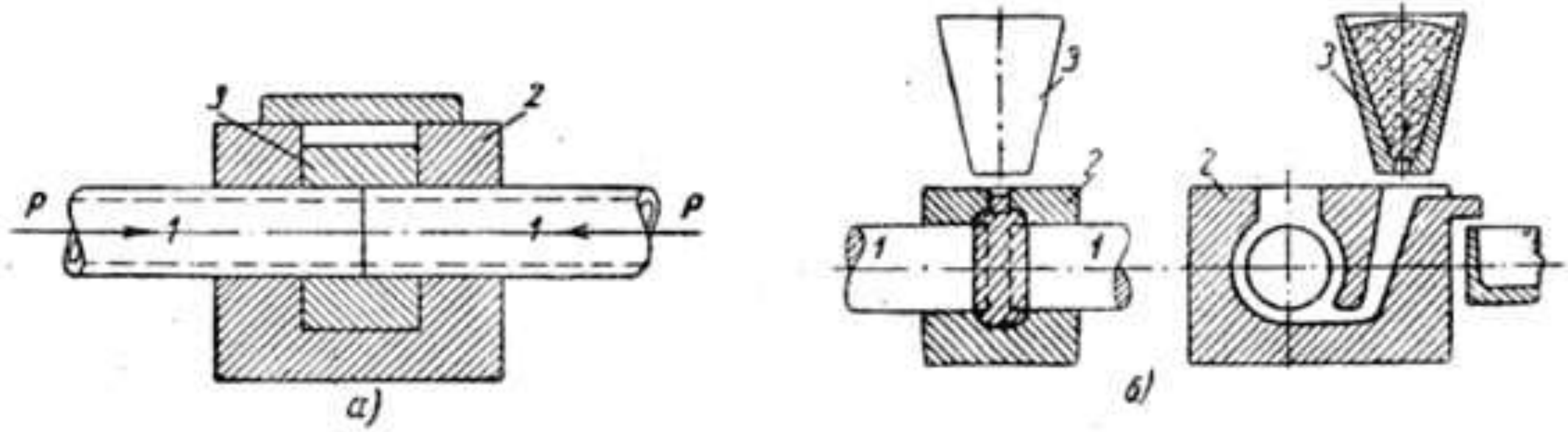
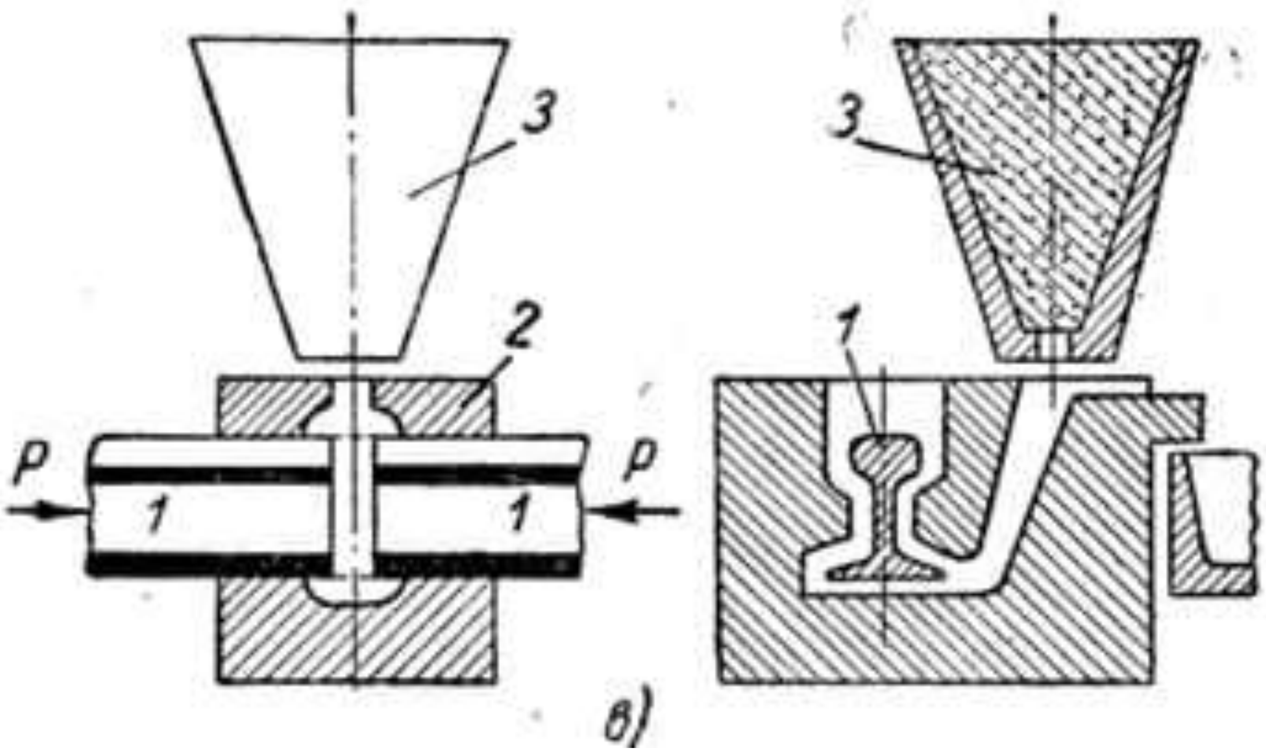


Рис. 2 Сухая форма для термитной сварки рельсов.





Фиг. 394. Термитная сварка

а — сварка давлением; *б* — плавлением; *в* — комбинированная: *1* — свариваемые детали; *2* — форма из огнеупорного материала; *3* — термитная смесь; *P* — силы, сдавливающие свариваемые детали.


https://www.youtube.com/watch?v=kuydZx-ckTs

1. Energy source

Classification of Fusion welding based on energy source

Energy source	Types of welding
Chemical	Oxy fuel gas welding, Exothermic welding/ Thermite welding, Reaction brazing/Liquid phase bonding
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Electric-Resistance	Resistance spot, resistance seam, projection welding, flash/ upset welding, Percussion, Induction welding

RESISTANCE WELDING

Class: Fusion Welding

Energy Source:

Electrical Resistance

RESISTANCE WELDING (RW)

A group of welding processes producing coalescence of the faying surfaces with the heat obtained from the resistance of the workpieces to the flow of the welding current in a circuit of which the workpieces form part and by the application of pressure. See Figure A.1. AWS A3.0M/A3.0:2010

RESISTANCE WELDING (RW)

flash welding	FW
pressure-controlled resistance welding	RW-PC
projection welding	PW
resistance seam welding	RSEW
high-frequency seam welding	RSEW-HF
induction seam welding	RSEW-I
mash seam welding	RSEW-MS
resistance spot welding	RSW
upset welding	UW
high-frequency	UW-HF
induction	UW-I

fragment of Figure A.1.

AWS A3.0M/A3.0:2010

RESISTANCE SPOT WELDING (RSW)

A resistance welding process producing a spot weld. *See Figures B.14(E), B.14(F), B.30(D), and B.46-50.*

RESISTANCE SEAM WELDING (RSEW)

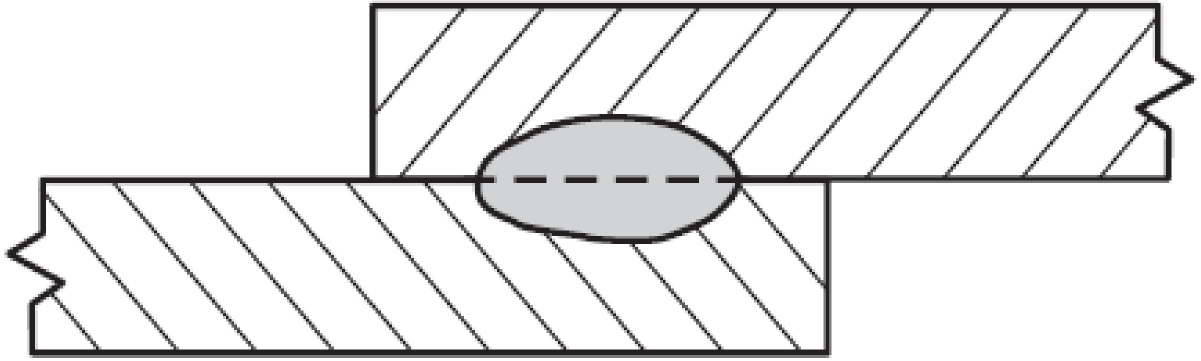
A resistance welding process producing a weld at the faying surfaces of overlapped parts progressively along a length of a joint. The weld may be made with overlapping weld nuggets, a continuous weld nugget, or by forging the joint as it is heated to the welding temperature by resistance to the flow of the welding current. *See Figures B.14(D), B.23(I), B.30(D), and B.52. See also* ***high-frequency seam welding*** *and* ***induction seam welding****.*

INDUCTION WELDING (IW)

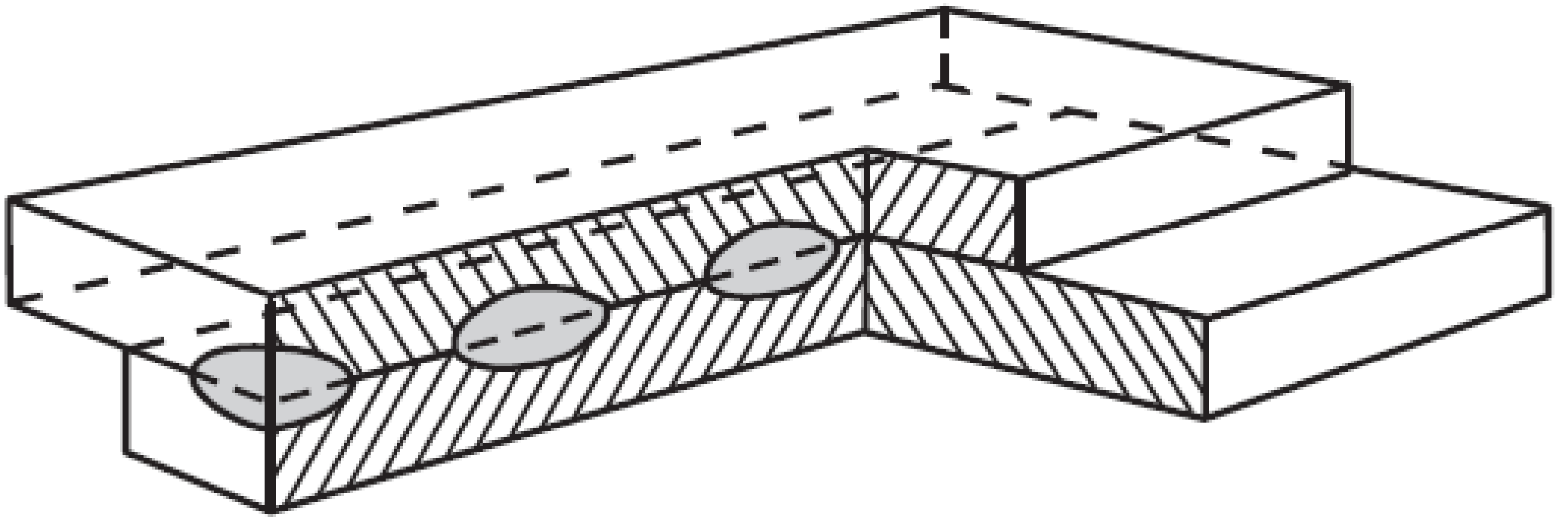
A resistance welding process variation in which heat results from the resistance of the workpieces to the flow of induced high-frequency welding current, with or without the application of pressure. See Figure B.52(E).

HIGH-FREQUENCY RESISTANCE WELDING.

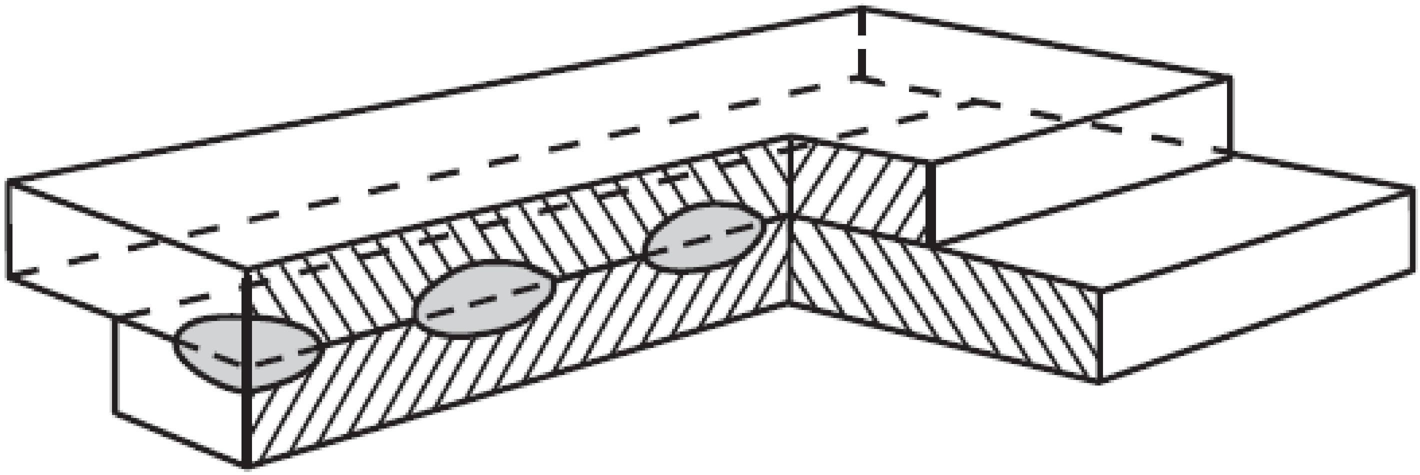
A group of resistance welding process variations using welding current of at least 10 kHz to concentrate the welding heat at the desired location. See Figure B.52. See also highfrequency seam welding, high-frequency upset welding, and induction welding.



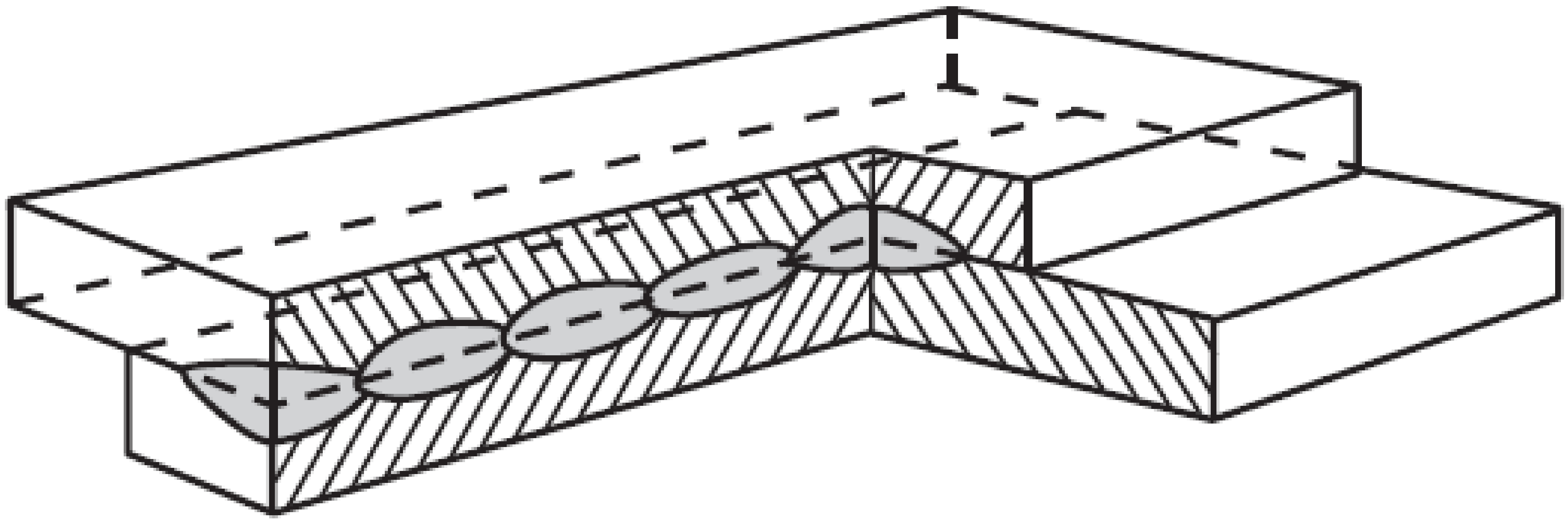
(E) SECTION OF RESISTANCE SPOT WELD



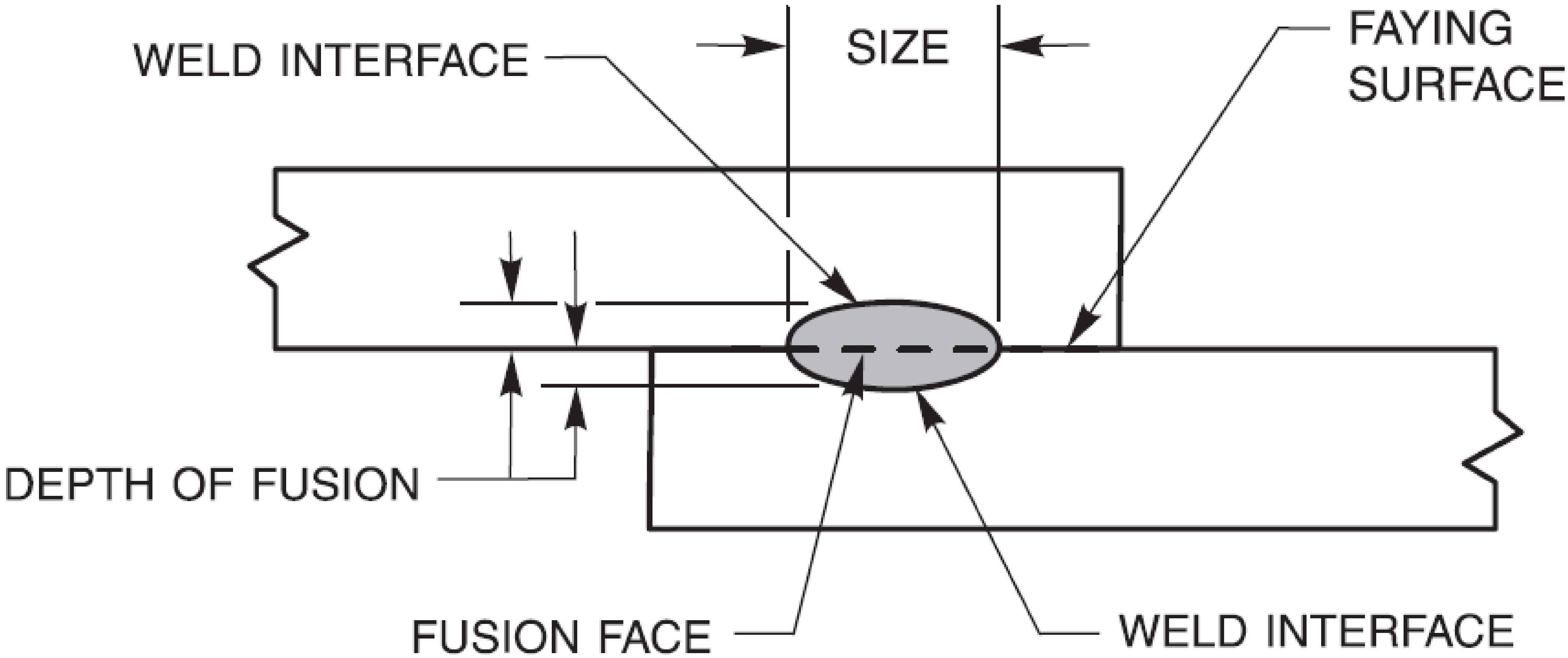
(F) RESISTANCE SPOT WELDS



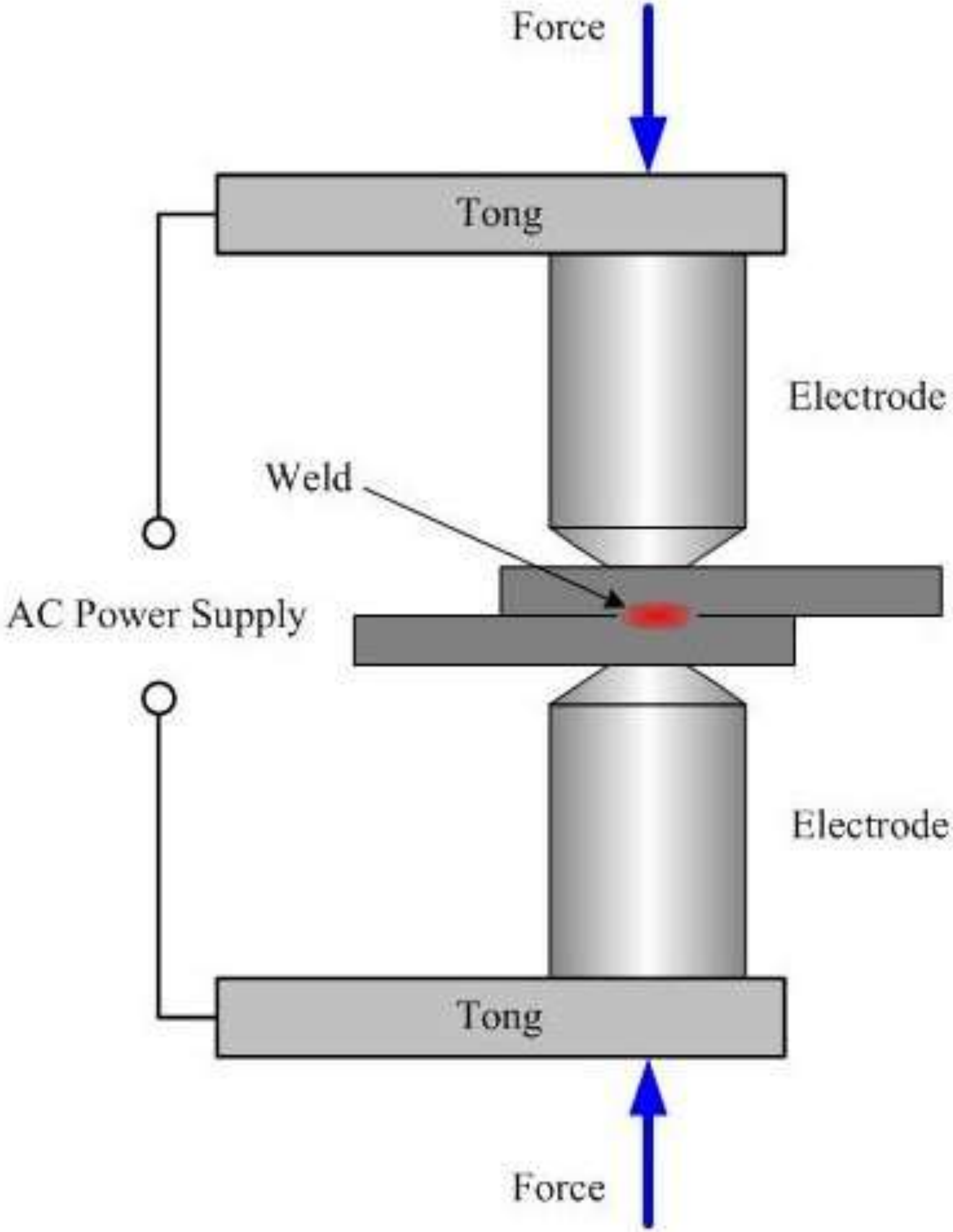
(F) RESISTANCE SPOT WELDS

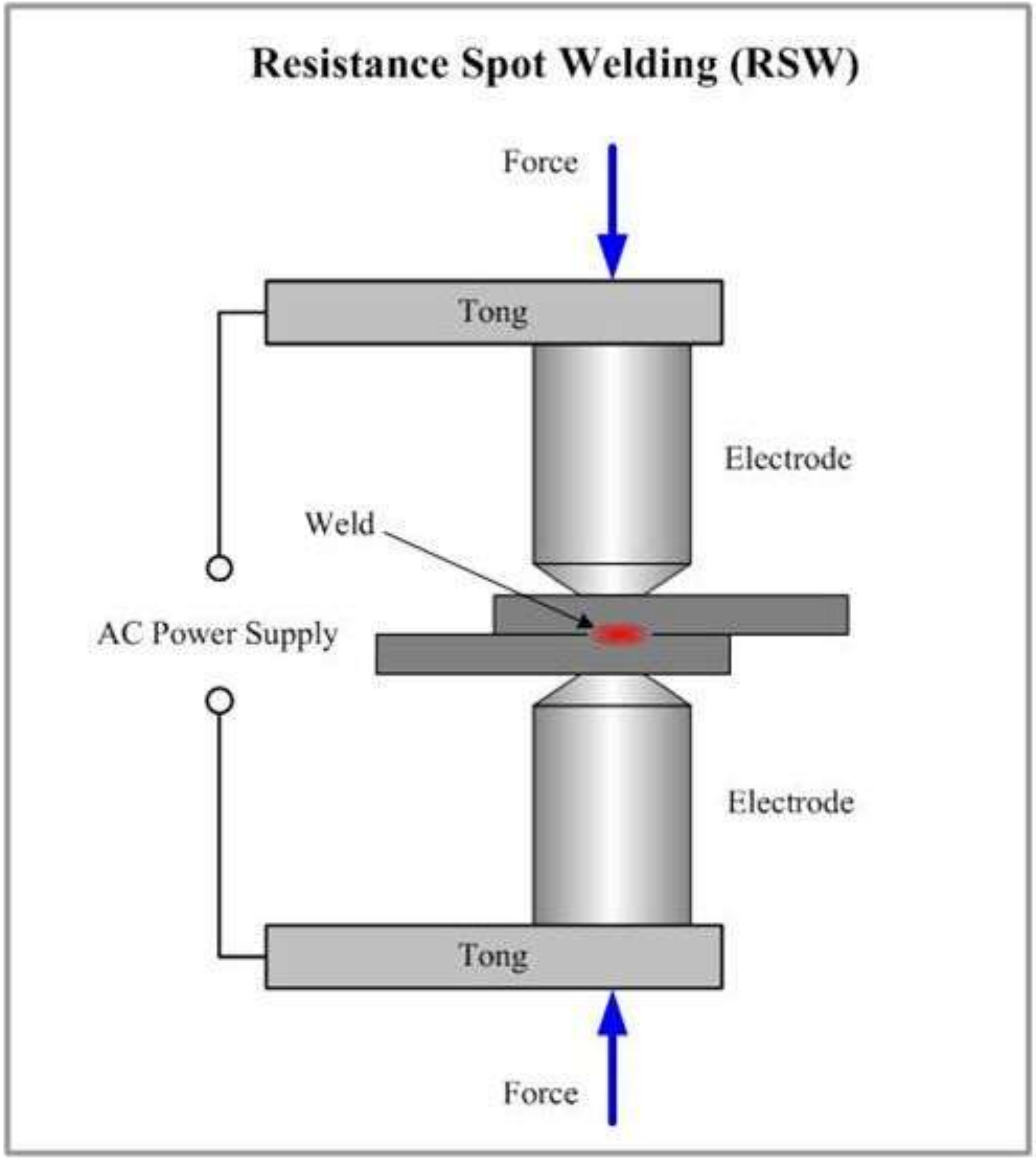


(D) RESISTANCE SEAM WELD



(D) RESISTANCE SPOT OR SEAM WELD (TRANSVERSE SECTION)


Force
Tong
Electrode
Weld
AC Power Supply
Electrode
Tong
Force



Diameter of the weld spot is in the range (3 - 12 mm).

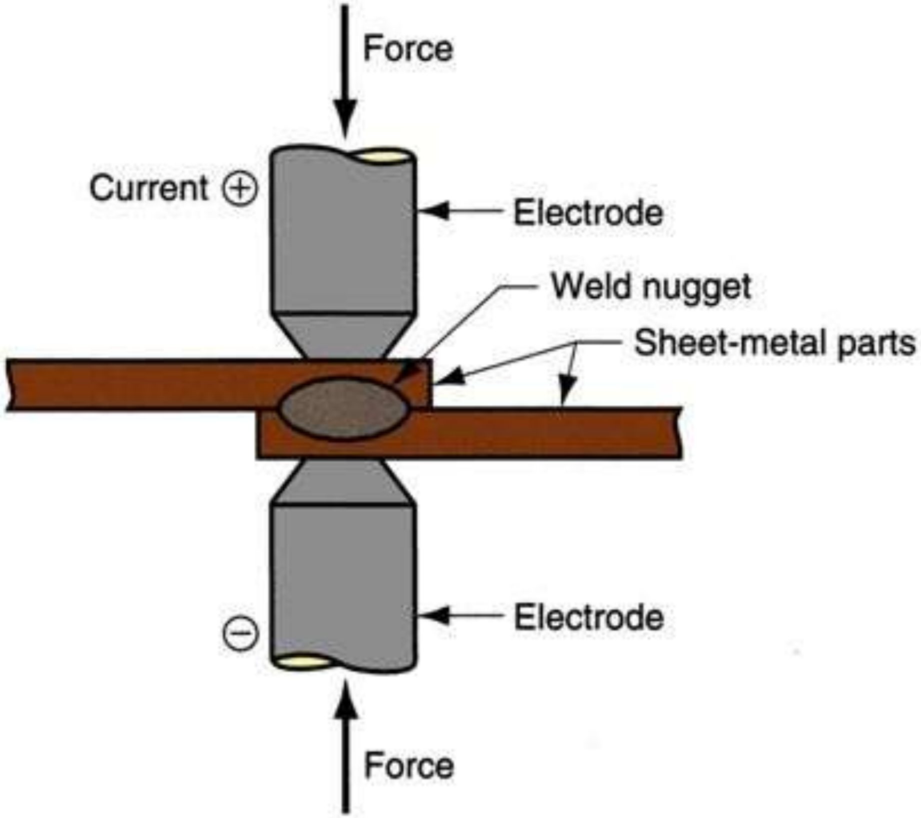
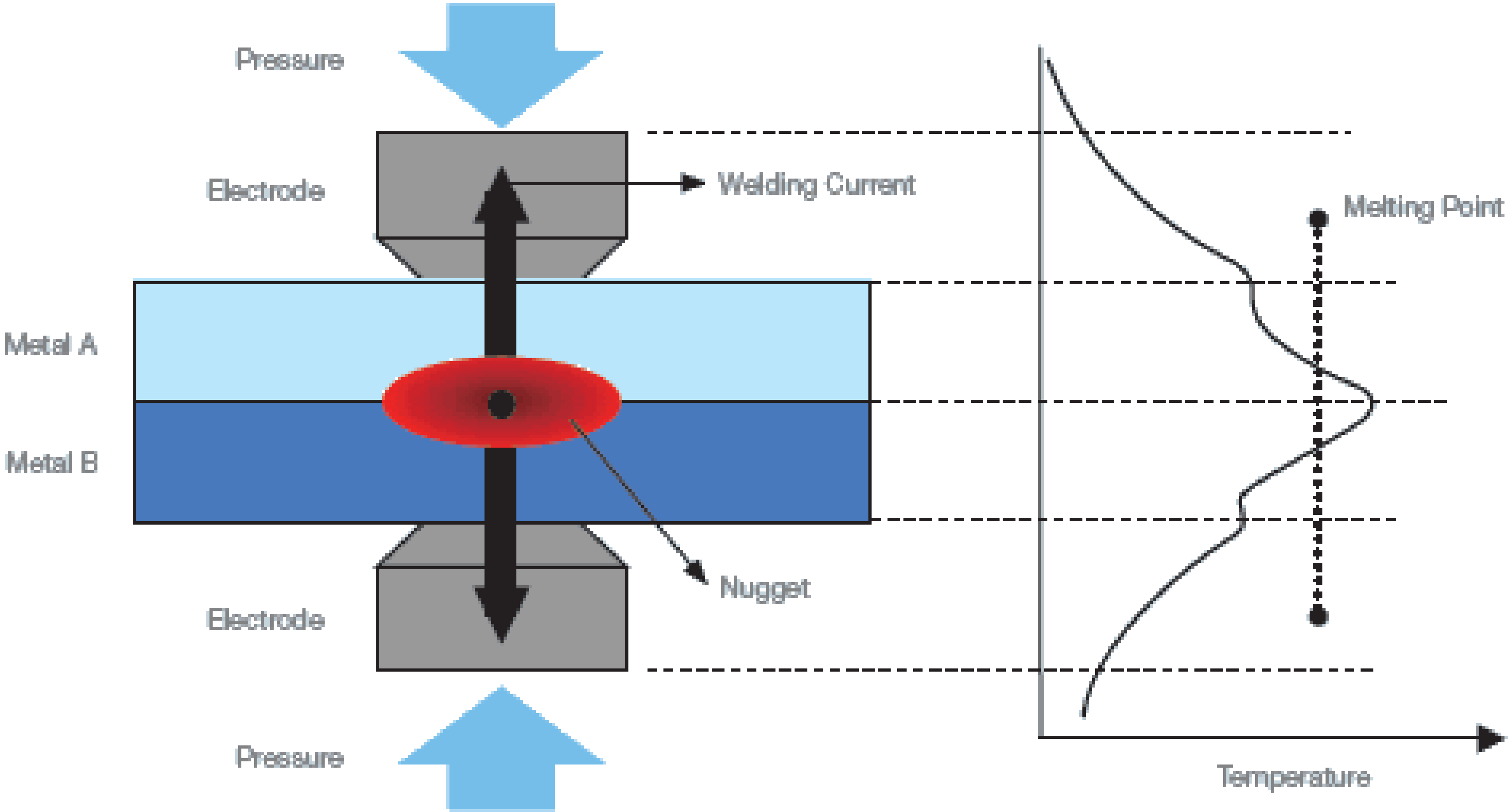


Figure : Resistance welding, showing the components in spot welding, the main process in the RW group.



Resistance Welding Model, Temperature Distribution at the Welding

www.avio.co.jp

How Spot Welding Works

Resistance welding techniques

Aug 2, 2008 10:26 GMT · By Gabriel Gache ·

Spot welding is a technique generally used to bond metals shaped into sheets no thicker than 3 millimeters. Unlike other welding techniques, spot welding can create precise bonds without generating excessive heating that can affect the properties of the rest of the sheet. This is achieved by delivering a large amount of energy in a short time in order to create controlled and reliable welds.

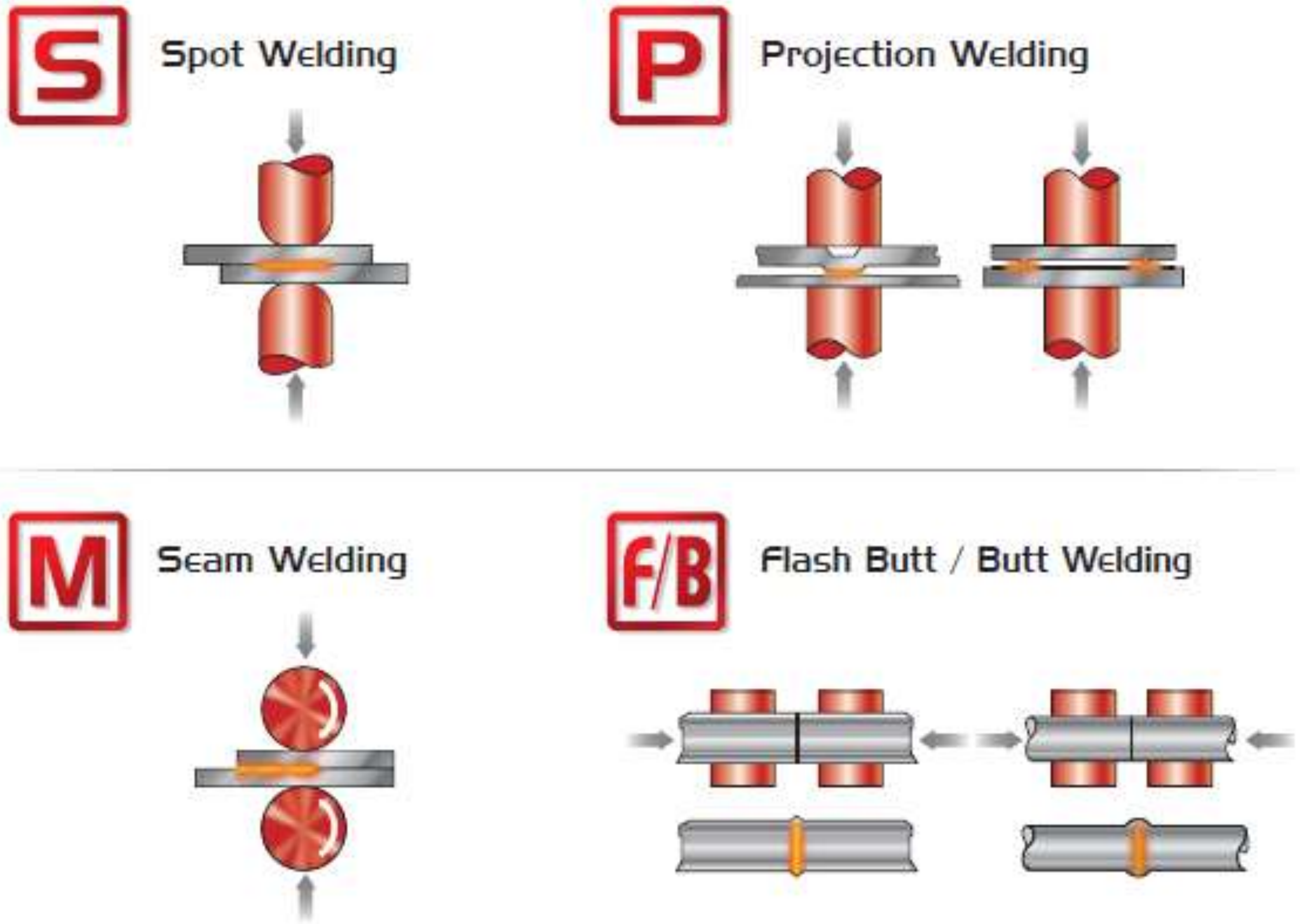
Typical spot welding machines make use of two copper alloy electrodes that are positioned over the area where the bond is to be made. The two sheets of metal that are welded are clamped by the two electrodes while a large electric current is run through them. The technique is also known as resistance spot welding, because the amount of heat delivered on the spot is directly related to the resistance between the electrodes, the amplitude of the current and the duration of the applied electric current.

As a consequence, different metals with various thicknesses require different current amplitudes, types of electrodes and time intervals. For example, if the machine is not properly adjusted it could end up delivering too little or too much energy to the sheets being bonded. In the first case, the amount of energy would simply be insufficient to melt the metals and bond them, whereas if too much energy is inputted the sheets would melt excessively, creating a whole in them rather than a weld.

The energy delivered during the bonding of two sheets must be available instantaneously. In the case of high power demands, the power supply is usually equipped with an energy storage unit, otherwise this constructive element is completely useless.

The electric current required for such applications is produced with the help of a step down transformer (with the electrodes forming the secondary circuit of the device), which lowers the voltage and increases the current (the voltage between the two electrodes rarely exceeds 1.5 volts, except for when there is no galvanic connection between the two, when the voltage increases to 5-10 volts, while the electric current can reach values up to 100,000 amps).


RobotWorx



http://www.dahching.com/en/about-5

Resistance welding is a fusion process which takes place between two metals under a certain load and heat without any demand of additional materials. The heat required during welding process is generated from the electrical resistance of the materials.

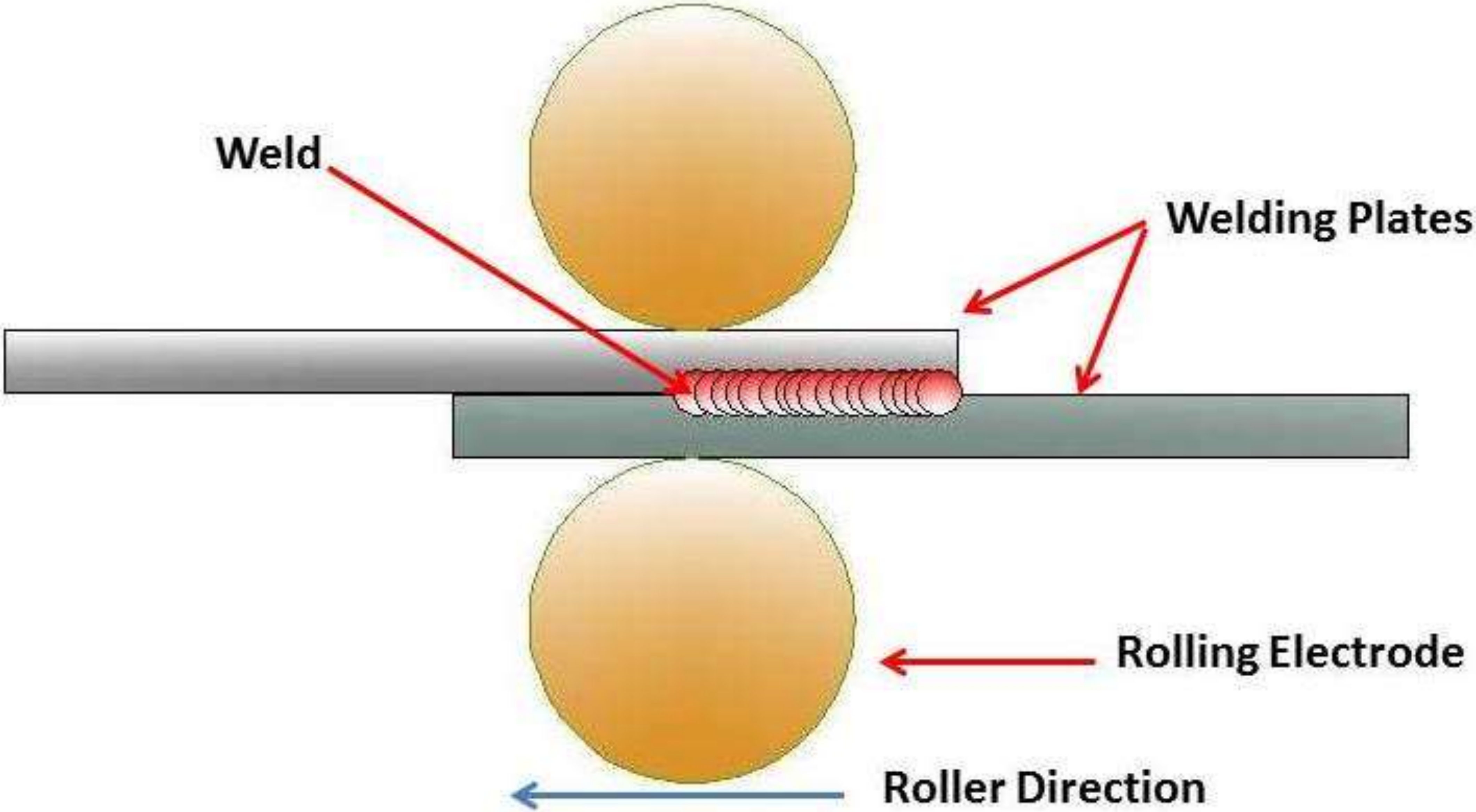
There are four types of welding methods in resistance welding: Spot Welding, Projection Welding, Seam Welding, & Flash Butt or Butt Welding.

Flash Butt or Butt Welding requires no overlapping of the joining metals among them. There are four types of Output Current solutions. Capacitor Discharge DC is not applicable in Seam Welding and Flash Butt / Butt Welding methods due to its intrinsic nature of instantaneity on current flow time.

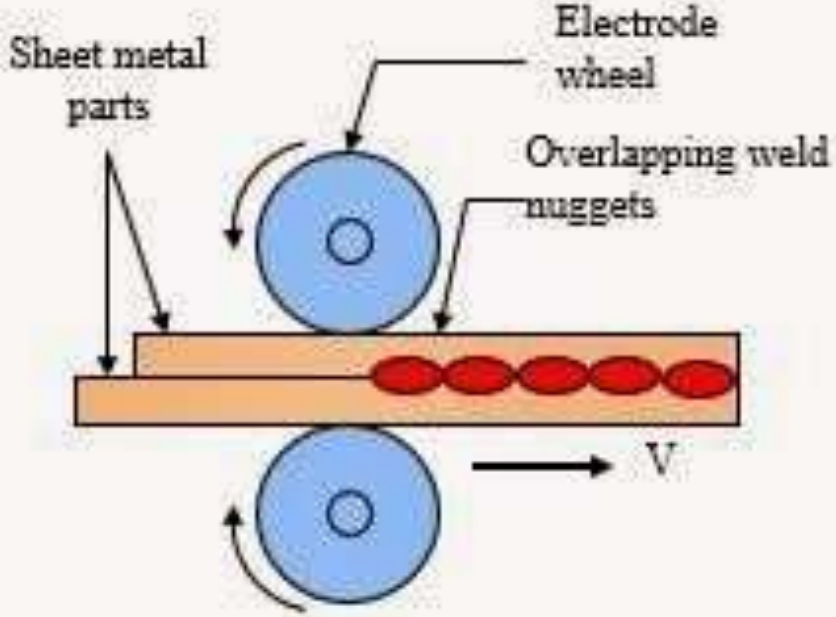
4 Welding Methods

Resistance Welding can be divided into four welding methods and four output current solutions.

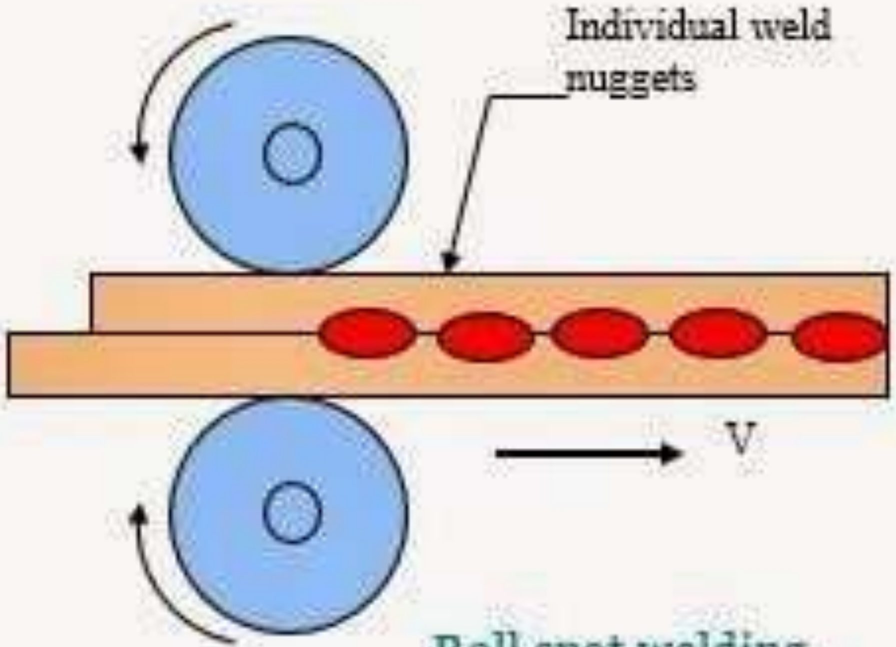
Schematic Diagram	Spot Welding	Projection Welding	Seam Welding	Flash Butt / Butt Welding
Single Phase AC	S	P	M	F/B
Capacitor Discharge DC	S	P	—	—
Three Phase Rectified DC	S	P	M	F/B
Three Phase Inverter DC	S	P	M	F/B



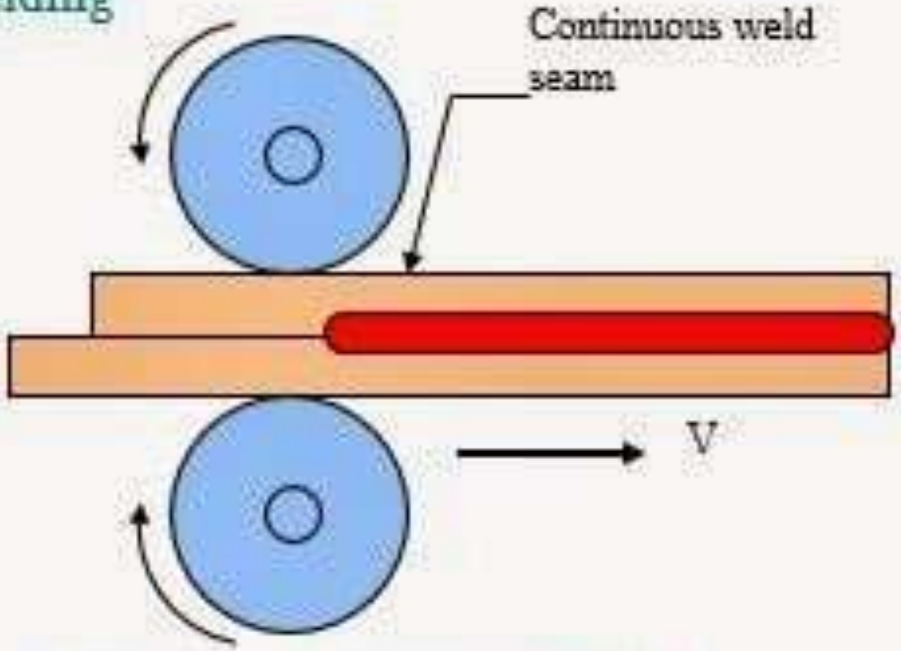
Seam Welding



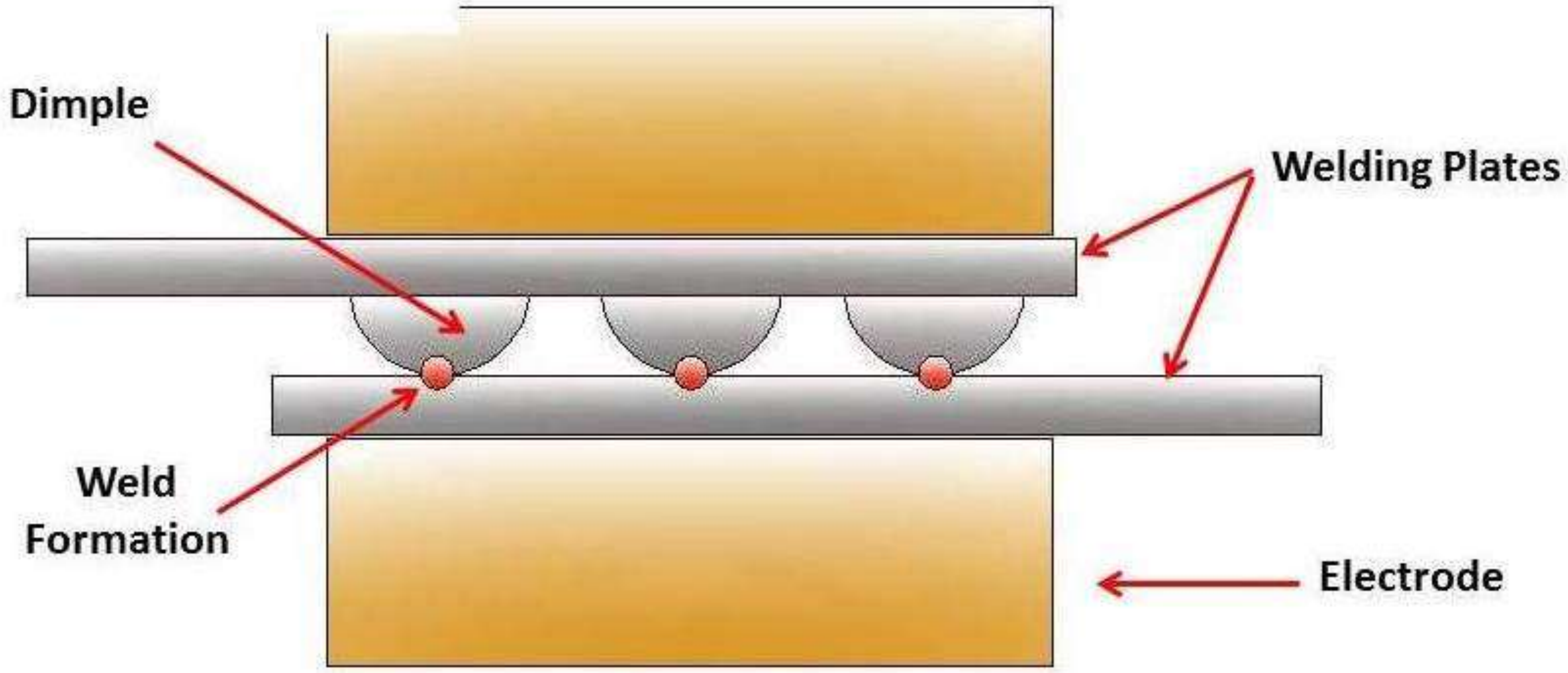
Conventional resistance seam welding



Roll spot welding

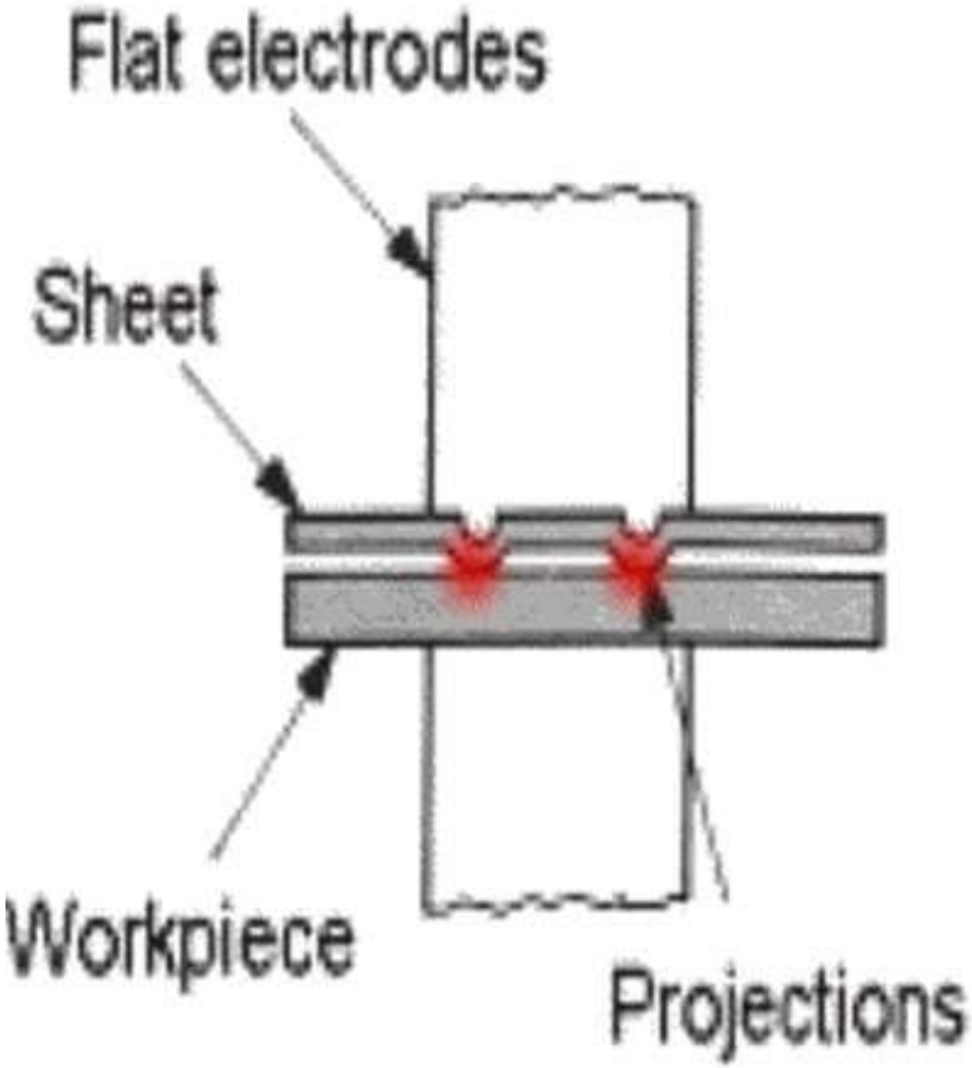


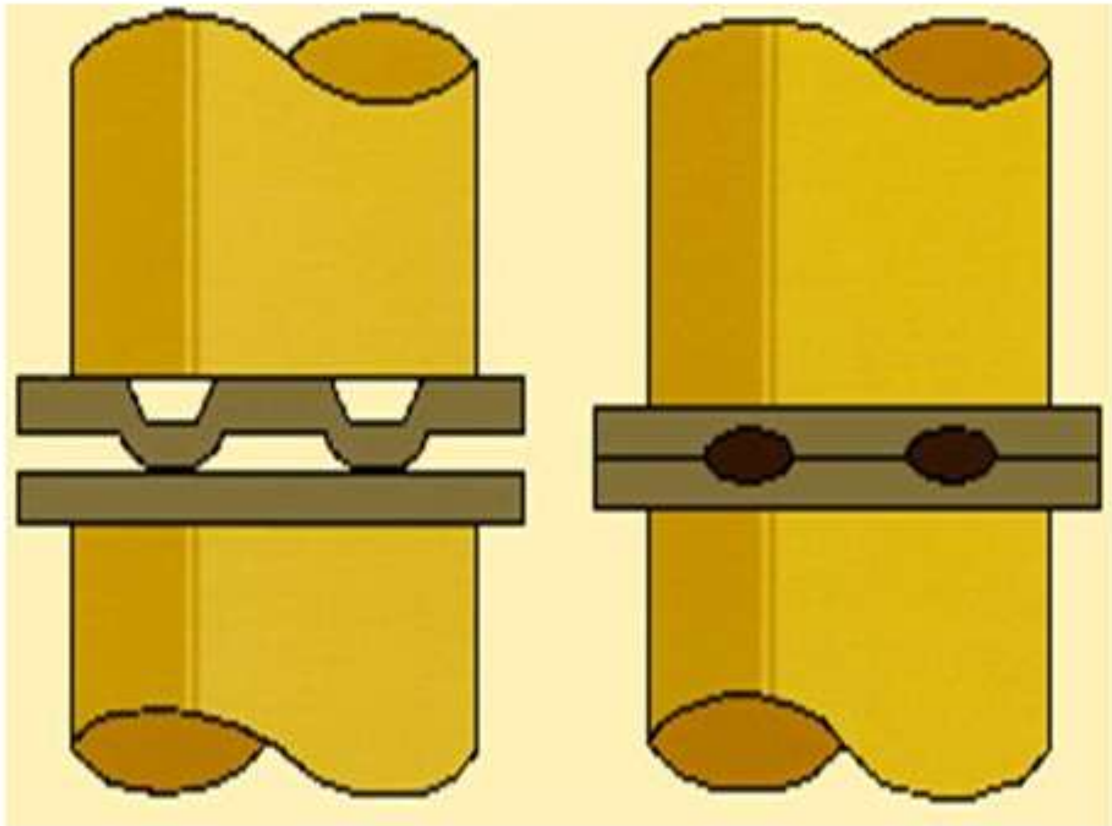
Continuous resistance seam



Projection Welding

Projection welding





http://techatmech.blogspot.com/2015/03/welding-mechanical-engineering.html

Projection Welding:

The projection welding process is similar to spot welding except that the welding pressure, and welding current. Hence the welding heat are localized by making projection or embossments on one or both of the work pieces to be joined. Such projections are made at all points where a weld spot is desired.

The projections have a diameter on the face equal to about the thickness of the stock and extend about 60 percentage of the stock thickness above the stock.

Operation:

The welding current is passed through the joint, welding heat is generated at these projections. Under the welding pressure the projections flatten allowing the two surfaces to be joined to come together. The melted projection becomes the weld.

The number of projections made in a joint should permit proper contact between the work pieces at the projections. The ideal number is three as the two sheets will always be in contact at three points. The maximum number of projections that can be satisfactorily handled is about six.

Special attention must be paid to the selection of correct pressing force at the beginning of the welding process. Use of excessive force causes the projection to collapse before the weld pool is created, which increases the contact surface and reduces current density. Variation in tensile strength of the workpiece may make welding more difficult, because it may result in projections of different sizes, in addition to which they flatten in different ways during welding.

When welding several projections at the same time, problems may occur in the heat balance of the joint or in the flattening of the projections. Problems can often be avoided by increasing the distance between projections. The recommended distance is four times the diameter of the projection.

Welding soft materials may be difficult if the workpiece thickness is less than 0.50 mm, because projections may collapse before welding current is applied.

For a successful projection weld the projections made on the parts should have the following characteristics:

1. The projections should be stiff enough to take the squeeze force before the current is passed.
2. The projections should have sufficient mass to heat a spot in the plane surface to welding temperature
3. The projections should collapse during welding without splashing between the sheets being welded.
4. The projections should be properly formed without any partial shearing.
5. It should be possible to form the projections without disturbing the other portions of the component.

Advantages of Projection Welding:

1. More than one spot weld can be made in a single operation, so the operation is very fast.
2. Welding current and pressure required is less
3. It helps in obtaining a satisfactory heat balance in welding of difficult to weld combinations of metals and thickness.
4. Closer spacing of welds is possible
5. Electrodes can be shaped to act as assembly fixtures for mass welding of parts
6. Uniform welds with good finish are produced.
7. Suitable for automation

8. Filler metals are not used. Hence clean weld joints are obtained

Disadvantages of projection welding:

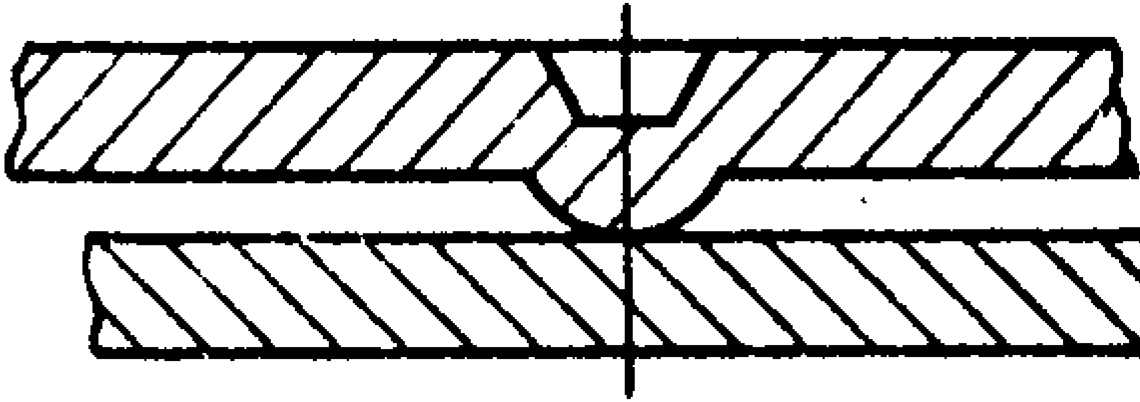
1. Projections cannot be made in thin work pieces.
2. Thin work pieces cannot withstand the electrode pressure
3. Additional operation is required after the welding process is over.
4. Equipment is costlier

Applications of projection welding:

1. A very common use of projection welding is the use of special nuts that have projections on the portion of the part to be welded to the assembly. Also, used for welding parts of refrigerator, condensers, refrigerator racks & grills, bushings, studs, nuts, handles etc..

Posted 17th March 2015 by KAVIN E

до сварки



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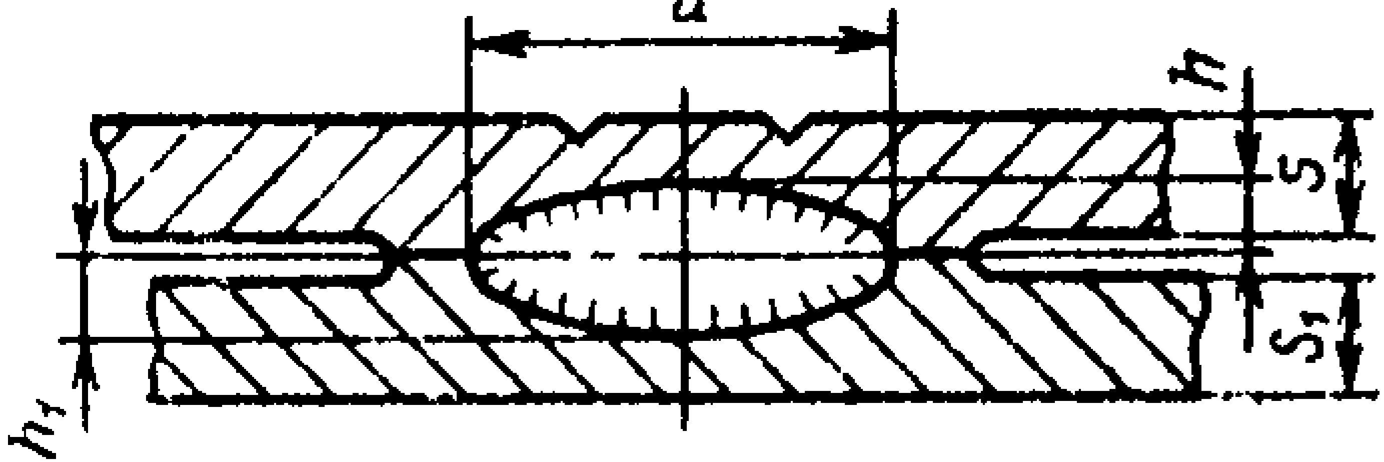
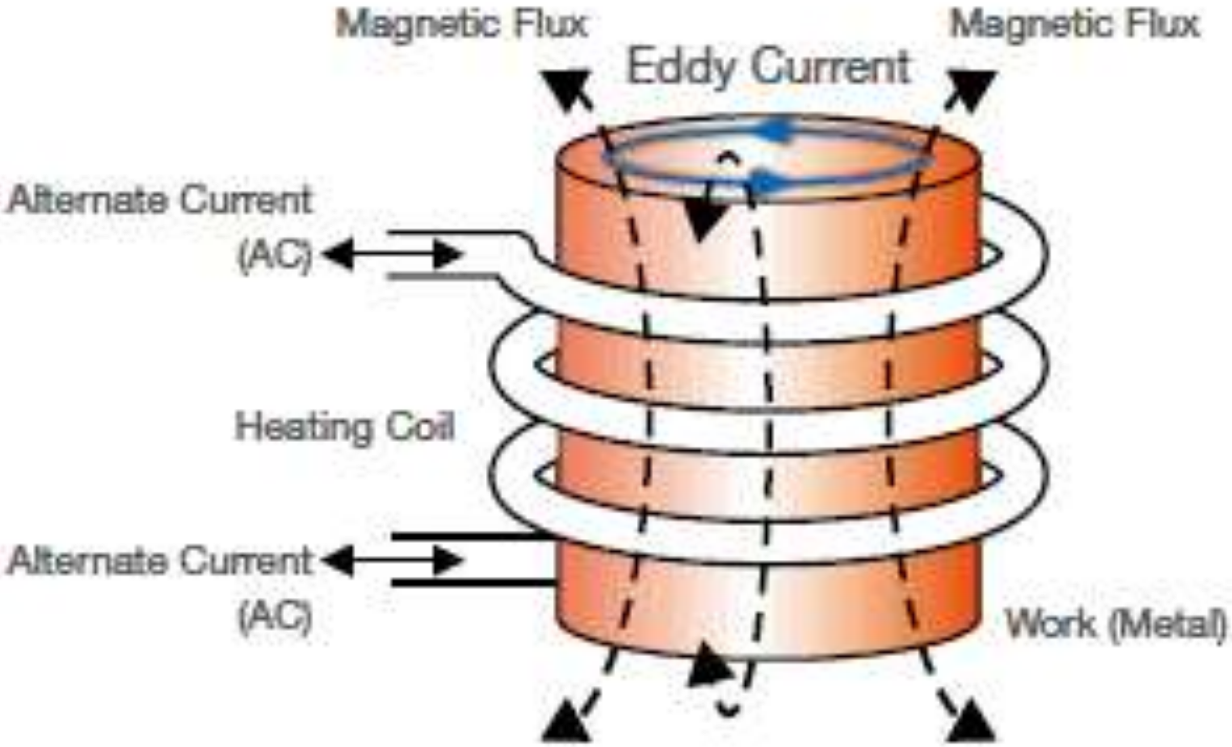
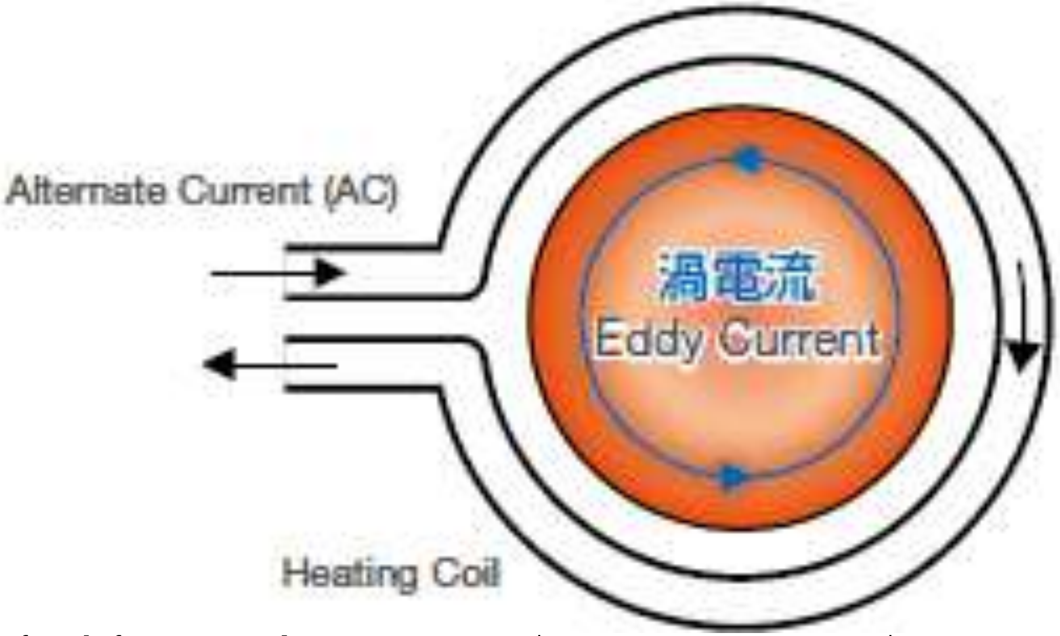






Principle of High-frequency Induction Heater Unit | Micro Joining Equipment | NIPPON AVIONICS CO.,LTD.
avio.co.jp http://www.avio.co.jp/english/products/assem/principle/highfrequency/index.html

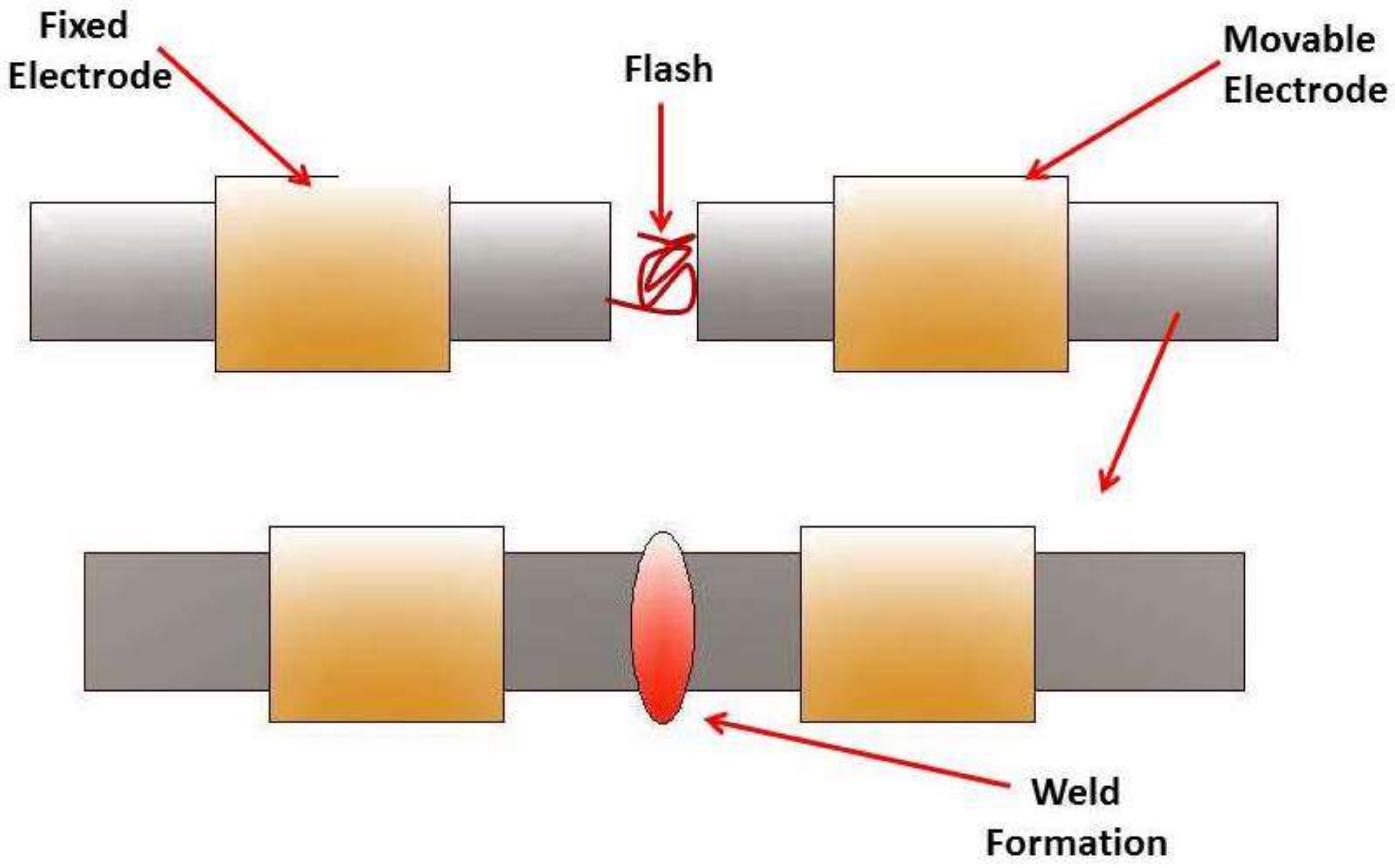
Principle of High-frequency Induction Heater Unit

Induction heater units incorporate high frequency generators for non-contact heating of metal using electromagnetic induction.

When AC is applied to a coil surrounding the work (metal), a magnetic field is generated by the current flowing in the coil, and induced loss (hysteresis loss) is generated causing a heat.

At the same time, in the magnetic field which alternates with the AC, a spiral current (eddy current) is generated by the electromagnetic induction. This eddy current generates Joule heating, and a heat loss of the electromagnetic energy (eddy-current loss) will be caused.

High frequency induction heating equipment performs heating by utilizing the two heating principle, namely hysteresis loss and eddy-current loss.



Flash Butt Welding

RESISTANCE BRAZING (RB)

A brazing process using heat from the resistance to the electric current flow in a circuit that includes the assembly. resistance butt welding. A nonstandard term for flash welding and upset welding.

RESISTANCE SOLDERING (RS)

A soldering process using heat from the resistance to the flow of electric current in a circuit containing the workpiece(s).

resistance seam weld size. See **seam weld size**.

resistance spot weld size. See **spot weld size**.

resistance welding control. The device, usually electronic, determining the welding sequence and timing with regard to the welding current waveforms, electrode or platen force or movement, and other operational conditions of a resistance welding machine.

resistance welding current. The current in the secondary circuit during the weld interval or weld time. See Figures B.42, B.49 and B.50.

resistance welding die. A resistance welding electrode matching the contour of the workpiece to clamp or shape the workpieces and conduct welding current.

resistance welding downslope time. The time during which the welding current is continuously decreased. See Figure B.49.

resistance welding electrode. The part of a secondary circuit responsible for the transmission of welding current and force to the workpieces. The electrode may be in the form of a rotating wheel, rotating roll, bar, cylinder, plate, clamp, or modification thereof.

resistance welding gun. A device used to apply electrode force and transfer welding current to the workpieces. It may be manipulatable or an element of a welding machine. See also **manual gun**, **manual transgun**, **servogun**, and **robot gun**.

resistance welding time. The duration of welding current flow through the workpieces in single-impulse welding. See Figure B.50. See also **weld interval**.

resistance welding upslope time. The time during which the welding current continuously increases from the beginning of the welding interval. See Figure B.49.

resistance welding voltage. The voltage between the resistance welding electrodes, measured across the workpieces.

resistance welding weld time. The duration of welding current flow through the workpieces in single-impulse welding. See Figure B.50. See also **weld interval**.

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

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

induction upset welding (UW-I). An upset welding process variation in which high-frequency welding current is induced in the workpieces. See Figure B.52(E). See also **high-frequency resistance welding** and **high-frequency upset welding**.

induction work coil. The inductor used when welding, brazing, or soldering with induction heating equipment. See Figure B.52(E).

high-frequency seam welding (RSEW-HF). A resistance seam welding process variation in which welding current of at least 10 kHz is supplied through electrodes into the workpieces. See Figure B.52(C). See also **high-frequency resistance welding** and **induction seam welding**.

high-frequency upset welding (UW-HF). An upset welding process variation in which welding current of at least 10 kHz is supplied through electrodes into the workpieces. See Figures B.52(A), B.52(B), and B.52(D). See also **high-frequency resistance welding** and **induction upset welding**.