Resistance spot welding

Resistance spot welding, usually referred to as spot welding, is a process that is widely used for joining thin sheet metal. This type of welding is commonly used in technology departments due to its fairly straight forward use and quick results.

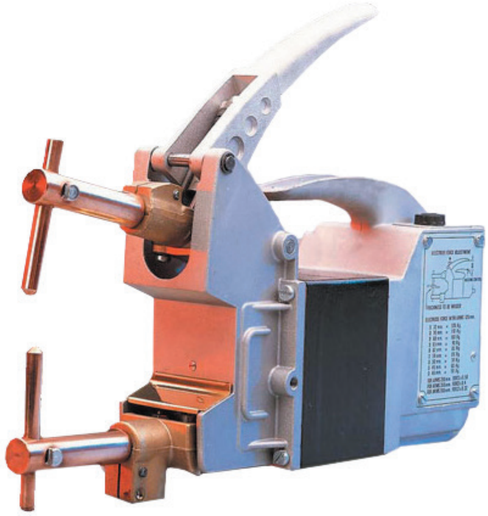

Figure 1 - Typical spot welder.

However, there are some tricky issues in the initial setting up of the spot welding equipment (see Figure 1) and as a result we have put together this quick and handy guide.

The process of resistance spot welding is undertaken by overlapping sheet metal and clamping it between copper electrodes, which have reduced diameter tips to produce welds that are usually between 1.6 mm and 12.5 mm in diameter. A large current is then passed through the work for a pre-set time, the higher electrical resistance causes local heating, sufficient to melt the metal. The pressure from the electrodes unites the molten metal once cool. This combination of heat, pressure and time is how each weld is produced. This is usually repeated multiple times along the length of the metal.

Pressure

The amount of pressure that is applied to the weld is an important factor in producing quality welds. If too little pressure is applied, the joining area will be small and weak.

If too much pressure is applied, then cracking can occur in the weld because the correct electrode tip angle will not be maintained.

High pressure can also cause thinning of the metal and cause a weakness. The depth of the depression on the sheet surfaces caused by the welding electrodes should never exceed 25 percent of the sheet metal thickness.

The primary purpose of the pressure is to hold the parts to be welded in close contact at the joint. This action assures consistent electrical resistance and conductivity at the point of the weld. The electrode tips should NOT be used to pull the workpieces together. Spot welding machines are not designed as an electrical "C" clamp. The parts to be welded should be in close contact before any pressure is applied. Investigations have shown that high pressures exerted on the weld joint decreases the resistance at the point of contact between the electrode tip and the workpiece surface. The greater the pressure the lower the resistance factor.

Thumbscrew pressure adjustment

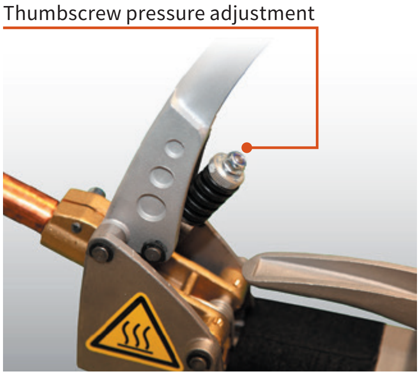

Figure 2 - Weld pressure adjustment.

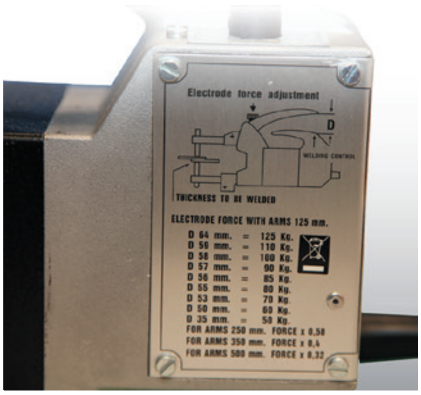

Figure 3 - Weld pressure forces.

Proper pressures, with close contact of the electrode tip and the base metal, will tend to conduct heat away from the weld. Higher currents are necessary with greater pressures and, conversely, lower pressures require less current from the resistance spot welding machine. The pressure is usually adjusted by turning the thumbscrew, situated directly behind the electrode arms (see Figure 2). A range of pressure forces for different circumstances is usually also located somewhere on the transformer body (see Figure 3)

Weld timer

The weld timer controls the amount of time the current flows into the welding transformer. In most cases several thousand amperes are used in making the spot weld. Such amperage values, flowing through a relatively high resistance, will create a lot of heat in a short time. To make good resistance spot welds, it is necessary to have close control of the time the current is flowing.

Most resistance spot welds are made in very short time periods. Since alternating current is normally used for the welding process, procedures may be based on a 50-cycle (UK mains frequency, fifty cycles = 1 second).

>>

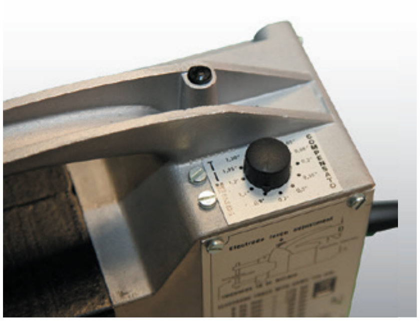

Figure 4 - Timer control.

Figure 5 - Welding times.

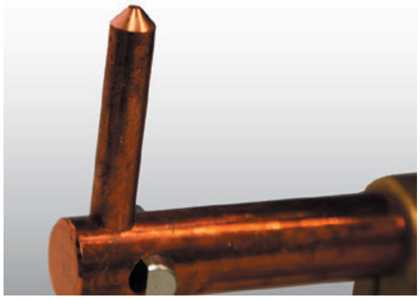

Figure 6 - Electrode angle.

Control of time is important in that if the time element is too long, the base metal in the joint may exceed well beyond its melting point. This could cause faulty welds due to gas porosity. There is also the possibility of expulsion of molten metal from the weld joint, which could decrease the cross section of the joint weakening the weld. Shorter weld times also decrease the possibility of excessive heat transfer in the base metal. Distortion of the welded parts is minimized, and the heat affected zone around the weld nugget is substantially smaller.

Generally, the time the current flows is control by setting the black control knob at the rear of the transformer (see Figure 4). The pointer can be turned to match up with the required time. Information on how long weld times should be, are usually found on a table at the side of the welder (see Figure 5).

Figure 8 - Electrode cutter fixed into drill chuck.

Electrode angles

As the spot welder is used the electrode tips, which are manufactured from chromium/copper alloy, will eventually wear and require refacing. Obtaining the correct angle (an included angle of 120°) on the electrode is important in achieving good weld penetration and thus weld quality (see Figure 6).

Angle cutting

There are a number of methods of achieving/maintaining this angle. The easiest and most convenient way is to purchase a purpose made tool as shown in Figure 7.

This small tool/cutter is used by fitting it into the chuck of a small power drill. It is then inserted over the electrode and spun at a slow speed. As the electrode must fit inside the profile cutter before any metal is cut it results in an accurate angle being achieved.

Another method of refacing the electrode tips is with the use of a specially adapted file, but this method requires some skill. You must hold the file at the correct level and angle, working back and forth around the tip's circumference, alternatively an ordinary hand file will produce similar results, if used with care. Whichever method is employed an included angle of 120° must be achieved.

Figure 7 - Electrode cutting tool.

Material preparation

To achieve good quality welds, it is essential that the metal to be welded is cleaned to a bare, shiny surface. Electrical current will take the shortest route of least resistance, therefore it is important that good flow paths are created by sanding/cleaning the metal with an abrasive such as emery cloth or a wire brush. One of the main difficulties with this form of welding is the difficulty in protecting the metal between the joint from corrosion once they have been welded. One method of overcoming this problem is to use products such as weld-through primer. These are painted on before the metal is joined together.

Weld spacing

The distance between each spot weld is of paramount importance if consistently good quality welds are to be expected. It should be not less than 25 mm. Spot welds produced at intervals closer than this are likely to be affected by a condition known as shunt, which can weaken then weld considerably (see Figure 9). >>

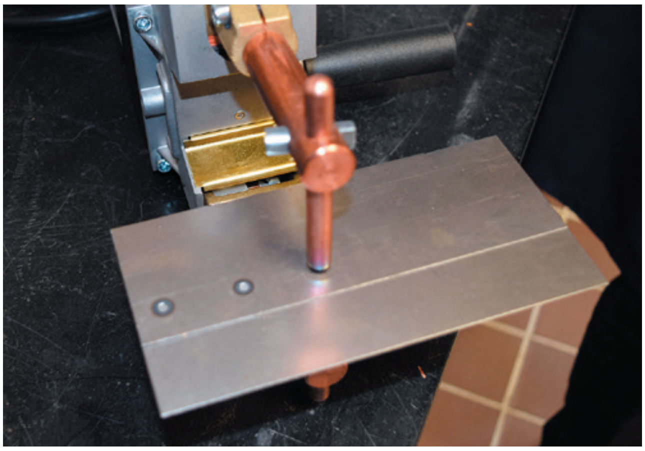
Figure 9 - Each weld should be spaced no less than 25 mm apart.


Figure 10 - Testing weld quality.

Weld quality test

The only way to ensure a series of welds is likely to be of high quality is to carry out a peel test. This should always be done with new equipment or in unknown situations. For example, to obtain the same degree of strength when welding two pieces of 0.9 mm (20 swg) metal, as opposed to three, a different time setting is required. When carrying out the test you will need a number of metal offcuts to use as test pieces. With the metal being "peeled" apart, a hole left in one plate would indicate a good quality weld.

Defect	Remedies
Blow-holes **Overheating** **Lack of fusion**	Lack of pressure between electrodes and workpiece, causing too much resistance on the outer surface of parent metals rather than between them where the weld nugget should be formed.
Overheating	Time setting for each weld too long.
Incomplete fusion	Time setting for each weld is too short.
Metal deformed or rough	Poor tip shape, incorrect angle, tips out of alignment, or electrode holder pivot points badly worn.
Metal falls apart	Insufficient weld time, or pressure, or dirty material, therefore no contact.

Weld defects/remedies

Compared to other forms of welding, few defects can be expected with resistance spot welding. However, faults that commonly occur are due to overheating, blowing holes, incomplete fusion and deformed metal surface. Most of these common faults can be attributed to improper adjustment of the spot welder. The following table specifically refers to faults/remedies when welding low carbon steel, though it can provide useful reference of other applications. <<

What is creativity?

We are delighted to confirm that Dennis Sherwood from Silver Bullet [1] will be leading a 2-day residential workshop (27-28 May 2019) at SSERC during which he will explore the following questions:

- Is 'creativity' associated only with the so-called 'creative arts'?
- How does 'creativity' relate to 'innovation', 'invention' and 'entrepreneurship'?
- Is creativity a natural gift, with which the fortunate few are blessed? Or can creativity be taught?
- If it can be taught, what is the process?
- And once an idea is on the table, how can we judge, wisely, whether it is - or is not - a 'good' one?

Why not join us for what promises to be a stimulating and exciting professional learning opportunity?

Cost - £100 to include course materials and overnight accommodation. <<


Pi Equals 3, Bracton Centre (secure mental health unit).

Reference
[1] https://www.silverbulletmachine.com/.