AMADA

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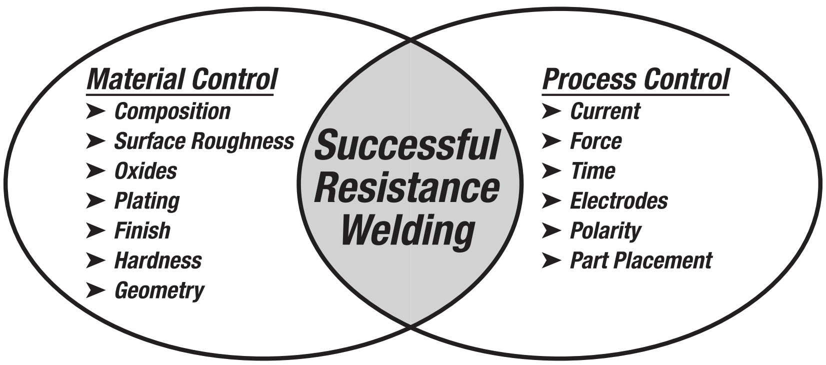
TECHNICAL APPLICATION BRIEF

Welding Material Control



GENERAL:

Successful resistance welding requires good process control in combination with strict material control. Today's advanced closed-loop power supplies and weld heads can compensate for slight variances in process and materials, however, steps should be taken to ensure consistency in the geometry, composition and surface conditions of the parts to be welded. This Nugget will detail how common material problems can lead to resistance welding inconsistencies.

BACKGROUND:

The electrical resistance of the work piece affects the heat generated in a resistance weld. Higher work piece resistance typically results in greater generation of heat. The electrical resistance is determined, in part, by the composition, hardness, surface conditions, and geometry of the materials.

MATERIAL COMPOSITION:

The bulk electrical resistance of the work piece materials is a function of the alloy type. Work piece materials can generally be classified as either resistive or conductive. Resistive work pieces such as nickel and steel are easier to weld since internal heat is generated during welding. Conductive work pieces, such as copper, require larger currents to create the same amount of heat. Materials that are electrically conductive are generally more thermally conductive as well. Substitution of different alloys or non-controlled alloys in production can change bulk resistance values, which affect the amount of heat generated.

SURFACE CONDITIONS:

Work piece surface conditions are extremely important to welding consistency. Surface conditions, which include finish, oxides, plating, and brighteners affect contact resistance values. Increased surface resistance causes weld energy to be used on the part surfaces, resulting in weak welds.

SURFACE ROUGHNESS:

Rough surfaces can cause spitting and blowouts because the entire weld current is forced through a small number of contact points having high electrical resistance. Smooth surfaces, on the other hand, provide multiple current paths and even heat distribution.

OXIDES:

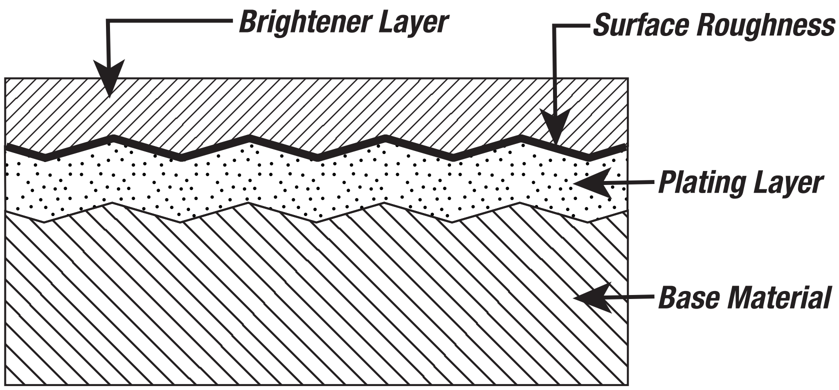
Oxides cause the weld heat to vary in magnitude because of variations in the electrode-to-part and part-to-part resistance values. Excess oxides can also contaminate the weld joint, reducing weld strength.

PLATING:

Variations in plating thickness and quality can also cause inconsistent welding. Thick plating tends to absorb weld energy, resulting in less heat in the weld area, and, therefore weak welds. Lack of plating quality results in oxides and particle contamination, which in turn causes material blowouts and electrode sticking.

Plating materials such as tin, solder, silver, zinc, and cadmium generally have very low melting points compared to the base materials. This can result in the plating material melting before the base material. The resulting joint can more closely represent a reflow braze or solder joint, which will not have the tensile strength of a diffusion weld.

Putting resistive plating such as nickel over a conductive work piece such as copper creates a very difficult welding situation. The two materials represent a thermal mismatch. If conductive electrodes are used to prevent over-heating of the nickel plating, the base copper material may not heat up. If resistive electrodes such as molybdenum are used, the plating can stick to the molybdenum.



Typical Workpiece Cross-Section

BRIGHTENERS AND FINISH:
Nickel brighteners and some passivating coatings are electrical insulators, which prevent the consistent flow of weld current. Generally, brighteners should be avoided if the parts are to be resistance welded. However, if brighteners must be used, use dual pulse welding technology to break through the weak brighteners and ensure a good weld to base metals.

MATERIAL HARDNESS:
Changes in material hardness will also cause welding inconsistencies. Hard work piece materials should be welded with soft electrodes to allow the electrode faces to seat against the work piece surfaces. Slower heating rates and upslope weld functions provide extra time to ensure good part-to-part and electrode-to-part fit up.

MATERIAL GEOMETRY:
Work piece dimensional control is essential for welding consistency. Work piece thickness is especially critical. If the thickness increases, a weak weld can occur due to reduced weld heat and increased work piece thermal dissipation characteristics. If the thickness decreases, the work piece may blowout because of increased heating. The relationship between thickness and required weld current is not linear because the thermal characteristics of the workpiece are a function of the workpiece volume.

Often, a projection is used to focus the weld current and balance heat. In projection welding, the projection diameter and height must be consistent from part to part. Projections that are too sharp cause excessive heating and blowouts due to increased weld current density. Projections that are too flat spread out the weld current, resulting in weak welds.

SUMMARY:
Material variations can have a dramatic effect on the consistency of the resistance welding process, yet they are the most difficult problems to detect as variations are not always obvious visually. This Nugget described solutions for many common material process problems. In determining the final process, material variations should be tightly controlled to ensure that they fall within the weld process window.