Resistance Projection Welding

What to look out for in projection welding of fasteners

BY LARRY KOSCIELSKI

> Projection welding can be a very reliable process when fundamentals are applied, even when welding exotic base metals.

Like so many others, the resistance welding industry has seen an unprecedented rate of change in the last few years. The development of new types of steels and other materials, innovations in product designs, new coatings and new technologies are aimed at addressing ever increasing demands in occupant safety, quality and challenging component weight targets. Many of these changes have had a substantial impact on the projection welding of fasteners.

Resistance welding in general relies on the precise control of current, force and time to create a weld using resistive heating. In some regards it is a "hot forging" process. In spot welding applications, there are a number of methods employed to monitor, control and react to normal variations in the process, materials and equipment conditions. Generally these strategies leverage the fact that spot welding is a slower and much less dynamic process as compared to projection welding.

Although both processes are resistance welding, in projection welding, there is very little time to deal with variations since cycle times are dictated, in large part, by the rate of collapse of the projections. Slowing the process down has an effect on the heat that is needed for the weld. Additionally, once the projections are collapsed, further heating is detrimental to the weld. Ultimately, these two issues are the controlling factors in the times used in the set up of the weld schedule.

Projection welding is a very dynamic process. As projections collapse, this triggers effects in both the force and the weld current profiles. The total weld may be as short as 10 ms and the collapse portion may be as little as 5-6 ms. In that time the welding machine is expected to "follow up" the typical 0.5 - 1.0 mm of the projection height - while still maintaining the weld force.

Some of the tooling used for projection welding of fasteners.

As well, since most weld projections have somewhat of a inverted trapazoid profile, the area of contact becomes larger as the projections collapse. This changes the force and current density per square mm during the weld time thus adding yet another dynamic in process.

Despite these challenges, projection welding can be a very reliable process when fundamentals are applied and variables are reasonably controlled, even when welding some of the more exotic base metals like Hot Stamp and Dual Phase. Controlling these variables begins with understanding them and only then taking appropriate action. When ignored, the end results can be catastrophic.

It is becoming clear that as we see applications making use of UHSS material

PROJECTION WELDING

(Ultra High Strength Steel) that the fundamentals become even more important, the fastener design becomes critical and often the window for success is narrower, requiring users to work harder to reduce any other variables.

Examples of welded fasteners.

So what should users look out for? Well, the short answer is anything and everything that will make any difference in the way the joint (each individual projection or as a set) sees the force, and the flow of current. Time is certainly an important process variable but can be effectively controlled in modern day weld controls.

Attention needs to be given to anything in the process or machine that adds variation to how the projections are affected by force and current. In our experience, that means there is "nothing that does not matter;" it is just a matter of what degree.

The following highlights only a few of the more common conditions that can be encountered; many more exist.

BASE METAL

Composition, Thickness, Condition and Coating

- Base material - in the case of dual phase material one area of a part may react differently than another
- Is the anti-corrosion coating thickness constant? –this is sometimes an issue when hot dipped galvanized is specified in place of electro-galvanized
- Is the part flat in the area where the fastener will be welded?
- Is the part coating building up on the electrodes?
- Is the coating such that you can even weld through it?

FASTENER

Design, Coating and Quality

- Is the fastener appropriate for the application? - Projection size, profile and hardness of the fastener all should be considered
- Is there a finish coating on the fastener itself causing an issue? Sometimes these coatings build up over time on tooling or, sometimes it becomes an issue right away
- Are the projections and electrode contact areas on the part consistent from part to part and are all projections on a given fastener dimensionally the same?

EQUIPMENT

Sizing, Specification, Controls, Tooling and Maintenance

- Are the machine, tooling and electrodes properly cooled? Is there are chance these are heating up at high production rates?
- Does the tooling allow the part to properly sit on the electrodes?
- Is the machine capable of following up properly?
- Is the machine sized properly (force and current)?
- Are the electrodes, weld pins and nut welding heads maintained properly and inspected at regular intervals?

These represent only a few highlights of the possible challenges and some ideas to consider. It is certain that change will continue, perhaps at an even accelerated pace, offering users an endless opportunity to learn and develop new solutions. These are certainly exciting times in the industryfor sure. **SMT**

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