CLINCHING SUCCESSFULLY INTO STAINLESS STEEL

by Leon M. Attarian

Self-clinching fasteners provide permanent and reusable load-bearing threads to accept mating hardware in metal sheets too thin to be tapped or where extruded or stamped threads would be impractical. Upon their permanent installation (usually during the fabrication process), self-clinching fasteners become integral parts of an assembly, will not loosen or fall out (even when the mating thread is removed), never have to be restrained from rotation with a tool, and never have to be handled again.

The fasteners further allow for repeated component removal and re-attachment as necessary (unlike welds or adhesives) and can significantly reduce loose hardware count by eliminating washers, lock washers, and/or nuts. Fewer parts enable lighter designs, quicker assembly, lower production costs, and optimized levels of end-product reliability.

Before these self-clinching benefits can be fully realized for stainless-into-stainless applications, however, adhering to some fundamental guidelines is essential to promote optimized fastener installation and performance in service.

Turning to the world of stainless, the following critical considerations will help point the way toward application success.

Ensure that the fastener is harder than the sheet in which it is installed.

A prevalent misconception is that all stainless self-clinching fasteners will perform as intended in all stainless steel sheets, regardless of the relative hardness of fastener and host sheet. This is not the case, based on how and why self-clinching fasteners install.

All self-clinching fasteners install permanently by pressing them into place in a properly sized hole and then applying sufficient squeezing force. The fastener's serrated clinching ring, knurl, ribs, or hex head is consequently into the panel surface, displacing sheet material into a specially designed annular recess in the shank or pilot of the fastener, known as an undercut. The metal displaced into the undercut secures the fastener against axial movement, while a non-round displacer secures the fastener against rotation to result in the fastener's permanent installation.

Due to the requirements of this process, the host metal sheet must always be sufficiently softer (typically 20 points on the HRB or HB hardness scales) than the fastener to prevent fastener deformation during installation. Sheets, too, must exhibit adequate ductility to allow the displaced sheet material to cold flow into the fastener's undercut without fracturing.

The inescapable conclusion is that stainless steel self-clinching fasteners made from 300 Series cannot be expected to perform reliably in 300 Series stainless steel sheets (the fastener must always be harder).

Ultimately, stainless steel self-clinching fasteners made from special-alloy or precipitation-hardened materials will provide the best overall performance installing into stainless sheets. A cautionary note, however: While 400 Series stainless steel fasteners can effectively be installed and will exhibit excellent performance in 300 Series stainless sheets, they should not be specified if the end product will be exposed to appreciable corrosive elements, requires non-magnetic fasteners, or will encounter temperatures in service above 300°F (149° C).

More tips concerning sheet hardness and installation:

- Ensure that the panel material is properly annealed. Annealing (a heat process) increases the ductility and reduces the hardness of the material to provide a more appropriate host panel for self-clinching fastener installation.

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- Ensure that the hole punch is kept sharp to minimize work hardening around hole, since work hardening can cause the critical area around the mounting hole to exceed the hardness limit.
- Ensure that the fastener is not installed adjacent to bends or other highly cold-worked areas, since bends or cold-worked sections will exhibit increased hardness and subsequently make fastener installation more difficult.

Determine the required level of corrosion resistance for the fastener.

Precipitation hardened stainless clinch fasteners will exhibit extremely high corrosion resistance suiting particularly demanding industry applications, such as medical, foodservice, fluid handling, and marine equipment and devices, among others.

Minimize chances for thread-binding issues from galling.

Self-clinching fasteners made from stainless steel may potentially encounter thread-binding issues related to galling. Galling is the seizing or abrading of threads caused by adhesion between sliding mating-thread surfaces—resulting in fastener damage and/or failures.

While not necessarily a widespread problem, mating threads can gall for any number of reasons before, during, or after the assembly process. Culprits include some material and finish combinations, fine and/or dirty threads, excessive tightening torque, mating part misalignment, or low-quality fasteners, among other possible causes.

The likelihood of galling can be minimized using preventive and proactive techniques. A preventive approach is to simply eliminate the factors known to contribute to galling. From the proactive perspective, tips include specifying or applying dry-film lubricant or anti-seize compound or choosing a fastener made from anti-galling materials or with anti-galling plating. Whenever lubricant is added or plating is changed, however, the torque-tension relationship will change, too. (Lubricants will reduce the tightening torque required for desired pre-load). In these cases, the tightening torque should be re-evaluated in turn.

Deliver sufficient installation force consistent with fastener thread size.

Stainless steel self-clinching fasteners featuring relatively larger thread sizes—dominating the automotive industry as one industry example—always require higher installation forces for proper fastener installation compared with smaller-thread clinch fasteners. For example, internally threaded nuts in 5/16-18 and M8 thread sizes would require installation forces of 14,800 lbs. and 66-80 kN, respectively. It is imperative that the installation press for a fastener be equipped to develop the necessary squeezing force for the job.

Choose the proper fastener type and style for the application.

Significant strides have been made over the years in developing "stainless for stainless" clinch fasteners to meet application requirements, whether for basic component attachment, stacking or spacing, or opening the door for subsequent access to assemblies. Among the notable families in the stainless clinch fastener category:

- *Stainless self-clinching nuts* provide strong load-bearing internal threads to accept mating screws. Upon nut installation, the reverse side of the sheet will flush and smooth. Styles include types with reduced outer dimensions and thinner sheet capabilities than standard and "floating" versions to compensate for mating hole misalignment, among other examples.
- *Stainless self-clinching thru-hole threaded standoffs* and *blind threaded standoffs* enable components to be stacked or spaced in an assembly. (Unthreaded types have been introduced for spacing multi-panel assemblies.) These fasteners are installed with heads flush with one surface of the mounting sheet, and in the case of blind styles, the outer sheet surface is both flush and closed.
- *Stainless self-clinching flush-head studs* mount flush in stainless sheets and include types demonstrating especially high hardness and corrosion resistance properties.
- *Stainless self-clinching captive panel screws* represent a new generation of "access hardware" for stainless applications. These complete, spring-loaded assemblies meet UL 1950 "service area access requirements" and their captive-screw design removes handling and installation issues associated with loose screws.

The portfolio of stainless self-clinching fasteners has further expanded to include studs offering externally threaded attachment points, swaging collar studs to accommodate multiple panels, fasteners allowing for flush "face-on-face" sheet attachment in stainless steel, and "micro" pins and studs ideally tailored for consumer electronics applications. And, as stainless applications continue to emerge and evolve, additional stainless self-clinching fastener solutions can be anticipated. ■

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