Self-Clinching Fasteners

Installed with a press, self-clinching fasteners provide load-bearing threads in thin metal sheets.

Self-clinching nuts, studs, spacers and other fasteners can help engineers meet design-for-assembly goals. ***Photo courtesy PennEngineering***

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The self-clinching fastener was created almost 80 years ago to provide load-bearing threads in metal sheets too thin to tap. Today, dozens of types of self-clinching fasteners in thousands of variations share this design advantage.

Self-clinching nuts, studs, spacers and other fasteners can help engineers meet design-for-assembly goals. These fasteners shorten assembly time and save money because fewer parts, and thus fewer steps, are needed for final assembly. Self-clinching fasteners can be installed during fabrication instead of final assembly. Hardware such as washers, lock washers and loose nuts are no longer required.

Self-clinching fasteners are relatively small and require less space for attachment. Their compact design and low profile can enhance product appearance and improve product reliability. Once installed, self-clinching fasteners do not loosen and will not fall out, preventing damage from loose hardware. The reverse side of the metal sheet remains flush—no swaged rim projects from the sheet.

As a rule, self-clinching fasteners should be selected whenever a component must be replaced readily and where loose nuts and hardware would be inaccessible. The fasteners are used chiefly where good pullout and torque loads are required in sheet metal that is too thin to provide secure fastening by other methods.

Myriad applications exist for self-clinching fasteners. They are used to assemble aerospace and automotive components, medical devices, electronic equipment, appliances, communications systems and countless other products. In many cases, these fasteners have enabled the development of thin-metal designs that would otherwise be impossible. The fasteners can be installed in metal sheets as thin as 0.012 inch.

"While self-clinching fasteners are inappropriate for heavy-duty structural attachment applications, there are many onboard automotive applications where self-clinching fasteners can play vital roles in reducing loose hardware, enabling secure attachment, and ultimately contributing to lighter designs," says Michael J. Rossi, marketing services supervisor at PennEngineering.

"Typical automotive mounting applications for self-clinching fasteners include air bag housings, battery covers, brackets, door trim, grill assemblies, mirror housings, and sunroofs," says Rossi. "Micro versions are being specified to secure critical onboard electronic systems, including navigation, communication, safety, and infotainment systems, among other examples."

Installation Procedure

Self-clinching fasteners are installed in metal sheets by pressing them into place in drilled, punched or cast holes using a press. Access to both sides of the assembly is required, but special hole preparation, such as chamfering or deburring, is not. Hole diameters should held to a tolerance of ±0.003 inch.

The pressing process causes displaced panel material to cold-flow into

a specially designed annular recess in the shank or pilot of the fastener, locking the fastener in place. A serrated clinching ring, knurl, ribs or hex head prevents the fastener from rotating in the metal when tightening torque is applied to the mating screw or nut. As a result, self-clinching fasteners become a permanent and integral part of the part or panel in which they are installed.

MSOFS flaring standoffs are manufactured from 300 series stainless steel and are offered in thread sizes #0-80, #2-56, and M1 to M2. They can be installed in panels from 0.008 to 0.012 inch thick. ***Photo courtesy PennEngineering***

The part or panel must be made of a ductile material that is softer than the fastener. As a rule of thumb, the material should be 20 points softer on the Rockwell B scale than the fastener.

During installation, it's important that the fastener be squeezed into place between parallel surfaces. A hammer blow or impact does not allow sufficient time for the sheet material to flow into the recesses of the shank and undercut. Sufficient squeezing force should be applied to totally embed the clinching ring around the entire circumference and to bring the shoulder squarely in contact with the sheet. Over-squeezing can crush the fastener head, distort threads and buckle the sheet.

When correctly installed, self-clinching fasteners produce little or no distortion of the sheet or damage to the finished surface. The fasteners should be installed after plating, finishing or anodizing.

Self-clinching fasteners can be installed with a manual, pneumatic or servo press, as long as it has adequate throat depth to reach the installation point.

For high-volume assembly, an automated press should be considered. Some automated presses are specifically designed to feed self-clinching fasteners automatically into punched or drilled holes in sheet metal and to seat them correctly with a parallel squeezing force. Feeding rates are up to six times faster than manual insertions, and squeezing action is adjustable to compensate for variations in the thickness and hardness of the sheet and the height of the fasteners.

"Perhaps the most significant boost to hardware insertion since the introduction of automatic tooling systems is the SingleTouch Part Handling Technology from Haeger, a PennEngineering company," says Rossi. "This technology enables a machine to insert up to four different self-clinching fasteners in a single handling of a part—saving assembly time and money."

Advances with fastener insertion machines also have emphasized operator safety and ease of use. Machines have become much more user friendly over the years. Innovations include the introduction of onboard programmable logic controllers, operator-friendly touch screens for guidance and progress reporting throughout the fastener installation process, and safeguards to reinforce operator confidence and the overall integrity of the installation system, says Rossi.

Manufactured from hardened alloy steel, SHTM hard panel nuts and HFLHTM hard panel studs are designed for installation into especially hard sheet materials, such as high-strength steel. ***Photo courtesy PennEngineering***

Fastener Types

Self-clinching fasteners fall into four main categories: nuts, studs, standoffs and panel fasteners.

Self-clinching nuts are used wherever strong internal threads are needed for attaching components. During installation, a clinching ring locks the displaced metal behind the fastener's tapered shank, resulting in high push-out resistance. High torque-out resistance is achieved when the knurled platform is embedded in the sheet metal. The force needed to install the fasteners will not distort or damage the threads, because the recommended shank length is always less than the minimum sheet thickness. The clinching action of these nuts takes place on the fastener side of the thin sheet. The reverse side remains flush and smooth.

Externally threaded self-clinching studs are used where an attachment must be positioned before being fastened. Flush-head studs are usually specified, but variations have been designed for high torque, thin sheet or electrical applications. Manufactured from a variety of materials, self-clinching studs are offered in a wide range of thread sizes. Studs are also available without threads for use as permanently mounted guide pins or pivots.

Self-clinching standoffs allow components to be stacked or spaced away from a panel. Through-threaded or blind types are standard. They are usually made of steel, stainless steel or aluminum. These standoffs are installed with their heads flush with one surface of the mounting sheet. When blind-threaded types are used, outer panel surfaces are smooth and closed.

Panel fastener assemblies are used on enclosures where the screw must remain with the door or panel. Usually spring-loaded, these fasteners offer the advantages of ease of assembly and quick panel removal

Panel fastener assemblies are used on enclosures where the screw must remain with the door or panel. Usually spring-loaded, these fasteners offer the advantages of ease of assembly and quick panel removal without loose screws. ***Photo courtesy PennEngineering***

without loose screws. Self-clinching panel fasteners are preassembled and manufactured in a range of thread sizes and screw lengths to satisfy various application demands. Separate spring-loaded assemblies have been created specifically for mounting printed circuit boards.

Variations of these four general categories have been developed over the years to meet emerging applications. Each offers a particular design, performance or cosmetic advantage.

Flush fasteners are installed completely flush within the metal sheet and are used when a thin sheet requires load-bearing threads but still must remain smooth with no protrusions on either surface.

Floating nuts have a floating threaded element that compensates for the misalignment of mating holes.

Locking fasteners have a metal or nylon core that requires the mating screw to be installed with a high prevailing torque. This restricts rotation of the screw under vibration.

Nonthreaded standoffs allow for quick assembly or removal of components without the need for screws or additional fastening hardware.

Concealed-head studs and standoffs are installed into milled, blind holes so that one side of the panel remains unmarred.

Blind fasteners have closed ends that limit screw penetration and are useful for protecting internal components from damage by inadvertent insertion of extra-long screws. Barriers protect the threads from damage and foreign matter.

Right-angle fasteners provide strong right-angle attachment points as a cost-effective replacement for bent edge tabs, bent center tabs, bent flanges, angle brackets, tack welds and loose hardware.

Self-clinching tie mounts provide secure attachment points for mounting wire to electrical chassis or enclosures.

New Products

Stainless steel applications for self-clinching fasteners have been increasing. "Stainless steel self-clinching nuts illustrate how one fastener often can

offer multiple benefits," says Rossi. "These types install permanently into ultra-thin stainless steel sheets where limited real estate is available for attachment hardware. This fastener's low height and small diameter allow for close-to-edge mounting without adversely affecting the host sheet."

In applications requiring especially high corrosion resistance, nickel plating adds extra protection. For example, nickel-plated stainless steel self-clinching standoff fasteners are used to mount, space or stack panels, printed circuit boards and other components in stainless steel assemblies.

Functionality requirements have also led to the development of new self-clinching fasteners. For example, PennEngineering recently introduced self-clinching locknuts for applications where vibration-related loosening could be problematic. The locknuts have uniquely modified threads that prevent loosening due to vibration. The thread formation allows mating screws to spin freely during installation until clamp load is induced.

The proliferation of compact consumer electronic devices has led to the introduction of micro self-clinching fasteners. For example, microPEM MSOFS flaring standoffs from PennEngineering can be used to attach and space components in compact electronic assemblies. They install permanently in thin panels of any hardness and material, including stainless steel, plastics and printed circuit boards. A unique flaring feature allows for installation into multiple panels.

These standoffs have a minimal footprint, enabling reduced centerline-to-edge designs. Their extremely small and reusable threads reliably accept mating hardware to complete final component attachment.

MSOFS flaring standoffs are manufactured from 300 series stainless steel and are offered in thread sizes #0-80, #2-56, and M1 to M2. They can be installed in panels from 0.008 to 0.012 inch thick using a punch flaring tool and a recessed anvil. **A**

SingleTouch Part Handling Technology enables a press to insert up to four different self-clinching fasteners in a single handling of a part. ***Photo courtesy PennEngineering***