Fastening Solutons: Plastic Clip-On Bosses for Thin Sheet Applicatons

by:
Laurence Claus, President
NNI Training and Consulting Inc.
14645 Old Rockland Road
Green Oaks, IL 60048
www.NNITraining.com

I have an older garden tractor that I use to cut my grass. Several years ago the engine began to puff smoke and quickly deteriorated to where it was evident that I either needed a new tractor or to rebuild the engine. Since a new, comparable tractor was not in my budget, I decided to rebuild the engine on my own. This meant removing the hood and cowlings to gain access to the engine so that I could take it off the frame and rebuild it. On this tractor, each side of the engine compartment is shrouded by a separate metal panel with two clearance holes in the top corners, which allow a screw to pass through and clamp the panel in place with a metal J-type clip located at a connection point behind the panel. Although this type of joint had worked fine for almost 30 years, after removing these screws and reconnecting them a couple of times, the much harder spring steel clip "stripped" the threads off of the softer screws and they began to back-out. Of course this created a problem when the tractor was running because there was no clamp load left and the panels would vibrate loudly.

Initially, my solution was to retighten the screws, later I began rotating them between joints, and finally I replaced the old screws with new ones. None of these solutions worked for long and I finally got fed up with it and decided to fix it for good. I could have replaced the joint with a nut and bolt or a rivet, but this would have severely limited the ease and speed of disassembly, which for the first couple of months after rebuilding the engine was important. Instead I dug into my drawer of samples and came away with several clip-on plastic bosses and mating thread forming screws for plastics that I figured I would give a whirl. These worked like a charm and I have had no subsequent rattling, yet the joint can and has been quickly disassembled when I have needed access to the engine (see before and after in **Figure 1**).

This article will explore these revolutionary little devices and show the high-tech nature of some of their more compelling advantages. I shall illustrate a number of these advantages with several products developed by **EJOT® Verbindungstechnik**, Bad Laasphe, Germany, a global innovator of thread forming fasteners and fastening systems, but other products exist that fundamentally possess some of the same advantages. Therefore, this article is intended to focus on this technology rather than any specific brand or style of plastic clip-on or press-in boss.

The Problems Seeking a Solution

As described above in the example of my tractor, a long standing joining method, particularly of thin sheets, has been to create a system with a metal clip acting as a nut member and a mating screw (usually a machine screw or case hardened, spaced thread screw such as a Type AB.) These systems have been used across many different industries for many years, but are especially prevalent in automotive and white good applications where large sheets or subassemblies may possess limitations that prevent or limit the creation of a nut member or utilization of other traditional joining techniques in certain areas. So as not to give the wrong impression, metal clip systems have been a respected fastening solution for many years. However, in some instances they present varied challenges such as poor retention, low stripping torque, cost effectiveness, poor ergonomics, incompatibility with recycling directives, and a proclivity to damage visible or painted surfaces during installation.

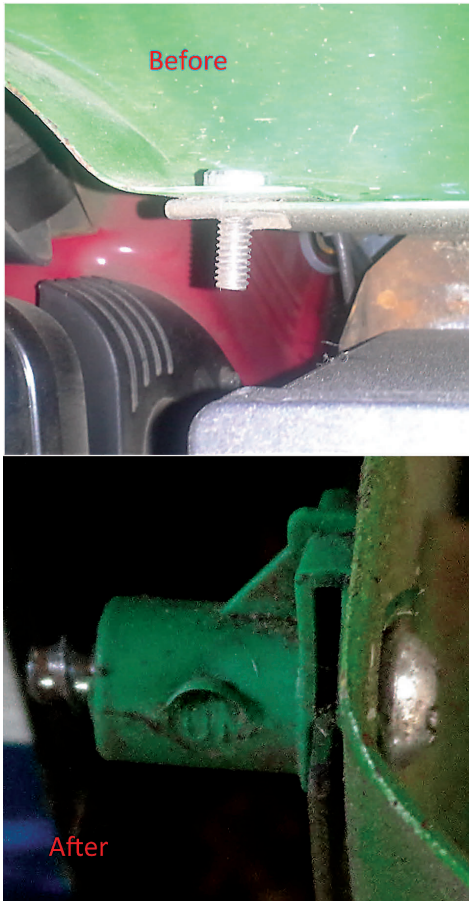

Fig. 1 — Before (above) and after (below).

How do They Work?

Whether metal or plastic, clip-on components work pretty much the same way. There will be a "clamped" piece and a "clamped to" piece. Both will possess a clearance hole or cut-out. In the clamped piece this hole allows clearance for the screw to pass through while being small enough to provide sufficient head bearing area to evenly compress the joint closed. On the "clamped to" piece, this hole serves not only as clearance, but also normally as an alignment and retaining means for the clip. The most common application is to slip these clips into place from the edge of the "clamped to" piece, but cut-outs can be

created to allow for application further from the edge of the "clamped to" component.

When the clip is pushed into place, the upper and lower portions of the clip flex away from one another allowing the clip to slide forward. As soon as it reaches the clearance hole either small detents built into the clip design will align in the clearance hole to assure proper position or the spring pressure of the clip will provide enough compression that the clip will align and stay stationary over the hole. The "clamped" part clearance hole is then aligned over the clip, a screw is inserted and the threading features of the system pull the joint together.

Normally metal clips are U-shaped or J-shaped, folded, spring steel sheet with the upper part of the clip having a clearance hole and the lower section of the clip possessing the nut member feature. Generally, these either have a "tab" which mates with the pitch of the screw's thread so that it will "screw" into the clip or the clip will possess an extruded and pre-threaded tube nut-type feature. Since these designs engage only a fraction of the available screw threads (in fact in some cases it is a very minimal amount) they often include sophisticated prevailing torque features to prevent the screws from backing out. Unfortunately, the more sophisticated the clip, the more costly it becomes. This limited radial thread engagement also presents a challenge during installation since torque must be closely controlled and limited to prevent stripping.

Unlike their steel counterparts, plastic versions are really clip-on bosses where the plastic tube becomes a nut member that requires thread forming screws to form the matng threads. Like their steel counterparts, they will have either detent features or spring compression that allows them to be retained in place, but the bottom side is often more "substantial" because it has a full plastic boss designed to mate with a thread forming screw for plastic. This inherently requires clearance on the back side of the "clamped to" part that may not be required by the flatter metal clip. However, in the metal clip systems the mating screw often protrudes well past the bottom of the clip so that the necessary clearance is not significantly different in either case.

Performance Advantages

A significant advantage of the plastic clip-on boss compared to a metal clip is consistency related to installation torque, clamp load and security from vibrational loosening. The plastic clip-on boss can be molded with a precise and repeatable pilot holes and outer diameter. When paired with the correct thread forming screw, the resulting drive and stripping torque performance will be very consistent and provide good margins between the two. In fact, many of these components have been designed to work as a system with a specific thread forming screw. Take for example the EJOT® Easy Boss® shown in **Figure 2**. It is designed specifically to work with the EJOT® Delta PT® screw. Thus not only is drive and stripping torque performance consistent, but each version already has a known and thoroughly predictable tightening torque. Using this established "know how" can be particularly useful in shortcuttng some of the development work that often goes along with designing the assembly parameters of a joint.

Clamp load, or the force that compresses and holds a joint together, is key in assuring the long-term security of

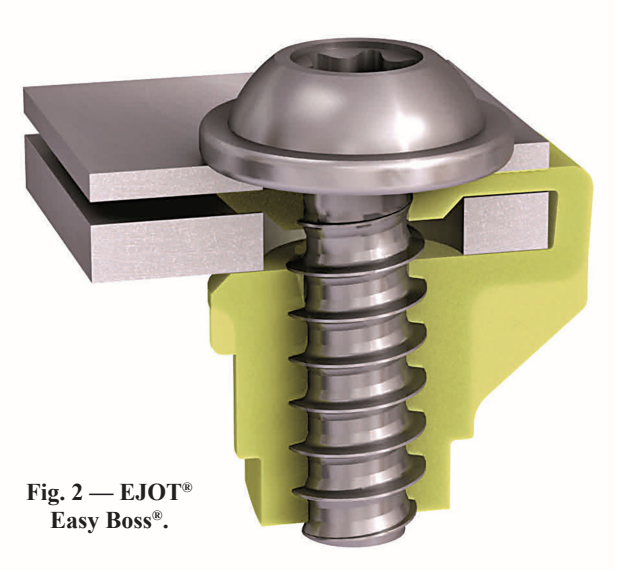

Fig. 2 — EJOT® Easy Boss®.

the joint. In other words, a joint that is absent clamp load is generally not a functional joint at all and will, in the case of these types of applications, result in relative motion of the items being clamped together to one another. This condition can lead to annoying rattles and squeaks or complete loss of the screw from the joint. In fact, if you have ever found a loose screw on the floorboard of your car, it is likely to have come from a screw and clip joint where the screw was stripped at installation or had minimal clamp load which was quickly lost once the car went into service. Since the clip-on plastic boss joint is normally designed as a system, the boss and screw parameters compliment one another resulting in optimal installation performance and clamp load. The other advantage of this strategy is that the complimentary design limits stresses which reduces joint relaxation. This provides security in the long-term against vibrational loosening and clamp load loss that results, at best, in annoying distractions such as squeaks and rattles and, at the worst, in complete system failure.

Installation Advantages

There are a number of installation and handling advantages that these types of plastic clip-on bosses have. The first is the ease and comfort of the operator that is manually installing the clip-on boss. These plastic versions often have a larger side wall surface area, which distributes the pressure exerted against the thumb during the push-on stage of assembly better than a comparable metal clip. If one has to perform this task a couple of times a day this is likely not significant, but if the task must be performed all day long, the ergonomic advantage of the plastic part is greatly appreciated by the installer. **Figure 3** illustrates a

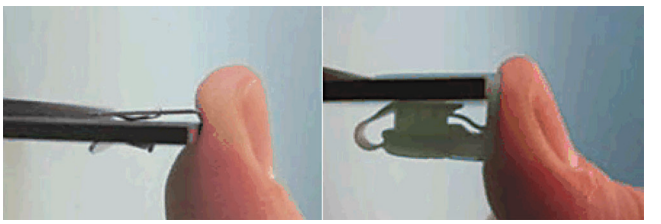

Fig. 3 — Comparison of how the thumb is impacted on comparatively sized plastic and metal clip-on components.

comparison of how the thumb is impacted on comparatively sized plastic and metal clip-on components.

A common problem with metal clips is their tendency to interlock with one another when bulk packaged . This can be very frustrating to an installer that is manually assembling parts and must take extra time to separate interlocked clips and downright disastrous when automatically feeding parts. The plastic bosses can be designed to prevent this interlocking and to be conveniently bowl fed for automatic installation.

Finally, it is common in large subassemblies to have a variety of mixed joints. For example, a standard automobile dashboard will contain a mix of joints that have molded-in plastic bosses and places where a connection is required, but it is impossible to mold a boss. In these cases the manufacturer must mix methods of assembly and utilize multiple different fastener types. However, a prime goal of manufacturers of these subassemblies is simplicity. This means one common screw with one common tightening torque is a desired outcome.

This however, is difficult or impossible if you are tightening a thread forming screw into a plastic boss and a Type AB screw into a metal clip. These plastic joints offer greater flexibility to accomplish this goal. They can use the same screw and tightening torque that other plastic joints throughout the subassembly are using. This can eliminate a great deal of unwanted complexity as well as reducing the number of part numbers and possibly suppliers.

Light Weight Initiatives

Replacing metal fasteners with plastic fasteners is a great tool in today's arsenal to reduce weight. This may not be particularly significant when replacing a single metal clip, but in large systems such as dashboards or door insert modules where this might be repeated dozens of times, the weight savings can be appreciable. Therefore, plastic clip-on bosses and other plastic fasteners provide a significant opportunity to obtain desired system weight savings.

Additionally, since the joints usually are engineered as a system, the boss and screw can be designed to provide the optimal use of materials and lighten the joint this way as well.

Other Advantages

There are a variety of other advantages that plastic clip-on bosses may provide. These include:

- End-of-life/recycling: Mating a plastic part with a plastic part may be a strategy that can be employed to address end-of-life issues and initiatives to have as much homogeneity of components as possible.
- Corrosion: Naturally when exposed to environments that are prone to corrosion there may be no better solution than a plastic clip-on boss, which is impervious to corrosion. Pairing the plastic clip-on boss with a stainless steel screw will provide a robust solution to almost any potential corrosion problems. This can be a particularly powerful tool in areas where the joint is exposed to corrosive elements and a metal clip is simply not a good option.
- Installation Damage: Sometimes a clip is required on a surface that is painted or has appearance requirements. Metal clips are very prone to scratching these types of surfaces during installation because they are generally much harder than the painted surface and have a variety of sharp corners and edges that are prone to scratch surfaces. A plastic clip-on boss is not subject to creating such damage and can usually be installed without creating any damage to the surface.
- Elimination of sharp points and edges: The plastic clip-on bosses can be designed and molded to have a small counter bore at the top side of the boss portion of the clip to help lead a screw into proper alignment and into the boss. As a result, the screw need not have a sharp point (many metal clip systems use a Type AB or similar sharp pointed screw). This is advantageous from several perspectives: 1. It is easier on the installer as it eliminates finger sticks from the sharp points. 2. It eliminates a safety issue of having sharp pointed screws sticking out the back side of the joint creating the possibility of scratching or cuttng anyone working around the part in service or during later assembly operations. 3. It eliminates the risk that these points can snag and fray electrical wiring that runs in close proximity to the screw (**see Figure 4**).

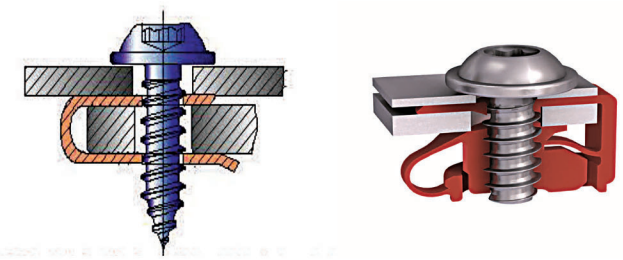

Fig. 4 — Plastic clip-on bosses eliminate sharp points and edges.

- The plastic parts can be produced in a variety of different colors. This may be beneficial in cases where appearance is an issue or a method of distinguishing different sizes is required.
- Molding technology has significantly advanced so that plastic clip-on bosses may be molded with unique and sophisticated variations that allow one part to work for a variety of sheet or panel thicknesses. Although not all plastic clip-on bosses have this functionality and there may be some differences between different brands and models, they all basically have a spring-loaded feature that allows the clip-on boss to be assembled to accommodate different size sheet and panel thicknesses. This provides a simplification factor that is generally appreciated by design engineers seeking assembly flexibility (see **Figure 5**).

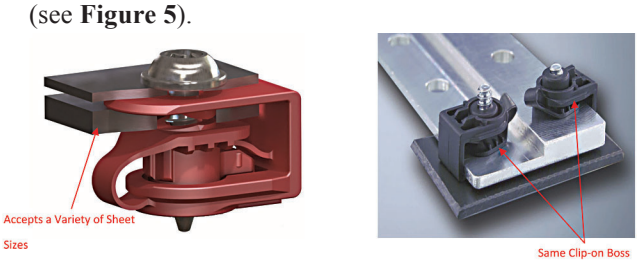

Fig. 5 — Plastic clip-on bosses can be molded with special and sophisticated variations.

Summary

Plastic clip-on boss systems provide an extremely good and high-technology alternative to the traditional metal clip systems. In addition to providing more consistent fastening performance, plastic clip-on boss systems also address multiple other difficult or expensive-to-solve issues such as corrosion, end-of-life issues, nonscratching, light weight and variability.

Plastic clip-on boss systems are an excellent state-of-the-art option, which is worth pursuing when a clip-on boss component makes sense.

Special Thanks

The author wishes to give special thanks to EJOT® Verbindungstechnik, which provided most of the pictures and illustrations for this article. Much of the content relates to advantages of different products that EJOT® has available in its Boss Family of plastic fasteners, Easy Boss®, Easy Boss V® and the VarioBoss®.

However, the ideas that are illustrated and expressed with these specific examples, although they are not necessarily universal to every competing product, are generally true of the products that have similar features and functions.

It was the intent of this article not to promote a specific brand or product, but rather to present an understanding of how plastic clip-on boss systems can provide advantages that traditional metal clip-on systems are simply unable to offer.

For further discussion contact **Laurence Claus** by email at **laurence@nnitraining.com**. Or to receive additional technical information on plasic clip-on bosses for thin sheet applicatons, visit the NNI website listed below.
www.NNITraining.com

FTI

Company Profile:

NNI Training and Consulting Inc. *is a dynamic, entrepreneurial 'knowledge provider' that offers training and consulting services to small and mid-sized companies. Our specific expertise is in cold heading, fasteners, fastener and application engineering, and automotive, industrial, and aerospace parts supply. NNI Training and Consulting provides training based on a strong foundation of theoretical knowledge combined with practical understanding and applied skills. NNI Training and Cnsulting offers consulting services on fasteners, fastener engineering and fastener quality; quality management systems and certifications; and business and sales development and strategy. Offering customers an unbiased perspective, technical expertise, solid business acumen, new ways of doing things and keen insight is the company's specialty.* ***www.NNITraining.com***