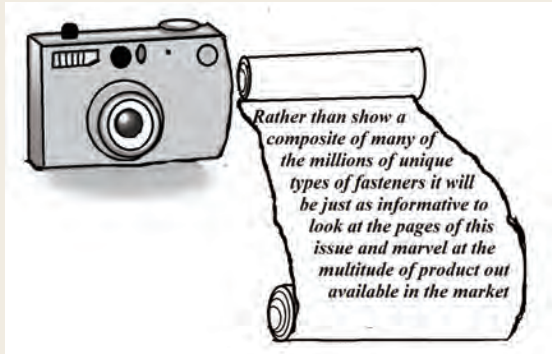


# Custom Fasteners 客製化扣件

There are thousands of fastener types, sizes, and finishes available to choose from when designing a joint attachment. With such a variety it seems that about every situation would be covered. Unfortunately there is always that one, unique attachment that cannot work with a standard part. A customized fastener is needed, one that will fit only that unusual situation.



The exact shape and type of a customized fastener is as open and as widely varied as human imagination can conceive; no listing or catalog could possibly show everything. However, when examining these 'one-of-a-kind' parts many of them show similar properties and can be sorted into several general classifications. To define what a customized fastener is- a fastener that has some feature or property that is unique to the specific application. I have grouped these several categories by generalized shared common features; custom heads, drivers, threads, materials and finishes, shoulders, and added on features. Although this is by no means a complete list (literally thousands of unique parts are in production) it is an attempt to get some order to the confused group.

**Group One: Heads.** There is always a case where a special head shape is needed, generally for cosmetic reasons although some physical requirements do happen. Many of these are applications where a standard shape or thickness of the head would infer (for example, door clearance). One example that I noticed was the refrigerator door hinge bolt which has a thinner head to allow the lower door to swing past when the upper one is closed. Another is the 'assemble yourself' furniture, so popular today, which comes with thin head screws which, when installed allow enough space in the mounting hole to install a wooden appearance plug. Often a special head shape is used on appearance items; special heads are designed for colored caps to be placed over the screws (again for cosmetic and appearance applications). To attach seats to tracks (airlines and transportation seating) a 'T' shape head is utilized which will fit exactly into the track and when installed, rotates slightly and prevents the fastener from coming out.

This is often turned around with a 'T' shaped nut which will slide in the seat mounting track and a standard shaped bolt. There are many examples of customized heads when you start to look at the applications around you.

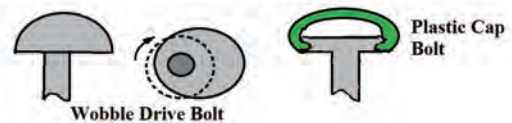
A development of oddly shaped heads (nonstandard sides, i.e., uneven lengths, odd number of sides,) which only fit with mating shaped driver bits is available. Originally designed to prevent unauthorized access, their cost and availability has limited their use. And unfortunately, they only deter the casual criminal. Identification by special head is another example of customization. The VIN plate (Vehicle Identification Number) which identifies an automobile model, serial number and, in the case of heavy trucks, the weight/loading limit, is held on with a special scalloped head rivet. The rivets are strictly controlled and not available on the market. This prevents the plate from being removed and another being substituted (stolen car). Or in the case of trucks, to prevent a plate showing the rating to be of a larger capacity (and more expensive) truck being attached and a fraud perpetuated on the buyer.

## Group Two: Drivers and Drives.

Most drives have started out as customized and, with expanded usage, became standard after a while.



Some typical security drives. There are many more

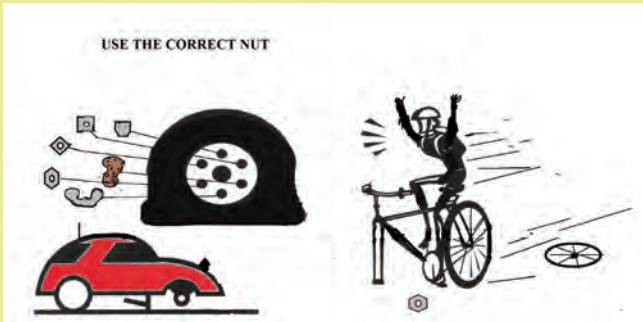


Cross recess was invented to prevent camout and paint damage when being installed into painted surfaces (mostly automotive at the beginning). It is an everyday, common recess now. The same with the star drives; the various styles available today are due mainly to patent concerns rather than any touted superiority of one's feature over another. Theft and security as well as preventing unauthorized access to panel boxes, devices, electrical components and so forth has led to the development of several customized drives. The star drive with a pin in the center could only be unturned with a specific driver (a feat that took the criminal mind only hours to figure out a way around it). There are several unique drives that required a very special drive bit to fit into the matching unique recess. The shape, length of



each side and how many sides vary and only an exact match in the drive bit will fit and function. By limiting the availability of these bits the possibility of unauthorized access was lowered greatly. The familiar 'one way' drive screws on bathroom doors are one of the security systems encountered every day. There are many others which tend to customize drive systems but are semi-common also. Once again, the availability of special drivers is no hindrance to serious criminals. These special recess fasteners work well except when repair is needed and no one seems to have the right bit. One unique driver that I remember seeing had the head of the screw (pan shape) set off-center to the screw shank. Called a wobble head screw, the driver turned the part by eccentric motion (it was only good for small screws as sufficient torque could not be developed). The same principal is used as a locking feature with asymmetrical bolts.

**Group Three: Special Threads.** Standard threads are designed so that they can be used and repaired, purchased, installed, etc. anywhere in the world. However, there are times when the application is meant to be 'touched' only by authorized personnel. One way that this is accomplished is by the use of a special or uncommon thread.



Two examples that come to mind are the threads on bicycles where only a special thread nut is capable of safely performing its function (holding the wheel onto the axle). Misuse of a substandard part may be injurious to the rider. The second example is also for the same reason. It is the wheel nut which attaches the wheel to the automotive axle. It is threaded with a non-common thread not readily available in the market. Why anyone would want to substitute any other nut is unknown but it has happened.

#### Group Four: Materials and Finishes.

Fasteners have been made of almost every conceivable material.

While I haven't seen a bolt made of edible material yet, I have a rubber bolt on my desk which I use



as an eraser. Its original purpose is, unfortunately, unknown to me. A recent article listed some of the exotic materials that bolts are made of and are available in industry (China Fastener World 41, Non-Steel Fasteners). Many of these are limited to aerospace and military applications with extremely large price tags. Occasionally a fastener is needed to be made of something unique. Threaded carbon rods are used to join the large carbon electrodes used in electric steel furnaces. They are consumed along with the electrode as it 'melts'. Wood fasteners are used in furniture and cabinetry production. One car company used purple colored rivets for mounting the heat shield under the chassis. With a great deal of parts, tubing, wires and so on under the vehicle it was extremely difficult to see if all the attachments has been made. The purple color was highly visible and the total number could be readily seen and counted. Fasteners made of composite materials, carbon fibers, and reinforced plastics are being designed for a variety of reasons; weight savings, non-magnetic, non-conductive, and impervious to radar are just a few properties that require a customized fastener.

Color matching for appearance fasteners has always been a problem. The usual choices were gray/argent and black. Painted parts rarely match the surrounding material and cause great deal of other problems with assembly, handling etc. Petro based chemicals like oils and paints cause stress cracking in many plastics and oil from operator's hands may stain surrounding materials and cloth. One way this has been solved is to custom coat the heads with colored plastic. Like all custom solutions this is costly but effective. In low load applications the rise of plastic fasteners has solved the problem somewhat. Rather than spend much expense the use of a hidden fastener is often chosen. These are parts that may be covered with a plastic cap, fasteners attached to the back of clips which are, in turn, attached to the back of the component, making them 'out-of-sight'. These types are discussed more below.

**Group Five: Shoulders.** Almost a common feature, shoulder bolts are both unique and common. There are many of them in production and some shoulder widths and lengths are listed as standard catalog items. On the other hand, the exact dimensions are often unique to the particular joint. Designers may change some dimensions to use a cataloged shoulder bolt but in many cases only a specifically dimensioned part will function. The shoulder may act as a spacer at times to prevent collapse of the thin and/or soft metal (or plastic) when torqued. It can keep adjacent components from touching (especially true with electronic circuit boards). It may also act as a pivot to allow movement without loosening (linkage arms in window regulators, seat belt attachments and anything with a 'open-close' lid/cover).

**Group Six: Added Features.** This is a 'catch-all' category because of its many various styles and functions. Many applications utilized a basic fastener but add on a special feature to meet the joint's special needs.



Bolt heads cannot always be held when being installed, necessitating some sort of device to prevent turning of the head when the nut member is turned (this is called a 'blind side' applications). This is usually done with an anti-rotation device (shaped like an arm) attached to the bolt. The bolt is placed through the hole and when the mating nut is installed the anti-rotation arm stops rotation of the bolt head, enabling the joint to be tightened. The concept of holding the head of bolt in a one sided operation is used in several modifications. Clip-bolt/screws which allow the part to be placed into a punched hole, facilitating blind side (one sided) installations, are a common customized fastener type. Again, the type is familiar but the exact dimensions, etc. are usually unique to the joint. The reverse situation is a more common occurrence. A bolt or screw is attached into a nutted member with little or no access to the back side. The internal part is held in a hole or onto the metal with the use of a clip or other holding feature. The often seen U-nut is a common example. However, when the designer cannot accommodate the use of a 'standard' U-nut a customized one is designed. The designs may incorporate a nut within a cage, a formed threaded one piece part (multi-thread or single thread U-nut type), or a special, unique, one-of-a-kind part. A well-known international clip/fastener company formerly put out a wonderful catalog of the clips, etc. that they manufactured. It was a great idea tool for thinking up that special part that you required. They dropped the catalog (which ran to several hundred pages) because of the cost and the obvious fact that unique parts do not have a current and large demand (plus with the invention of the Internet, published catalogs were obsoleted). Copies of that catalog are still around and are cherished by designers.

Many fasteners are customized with the addition of some performance enhancing feature; adhesive locking patches, deformed thread locking features, lock wire pin holes, slots, grooves, and so on. The use of high build paint primers to increase corrosion of the metal has led to the introduction of paint cutting grooves and styles to assist assembly. Also, special coatings to prevent the adhesion of the primers to the threads make those parts installed on the metal before priming (pierce nuts, weld nuts, studs, tapped plates,

cage nuts) customized parts.

Finally there is the field of clipping. To hide the appearance of attachment hardware many designs use a clip, mounted on the back side of moldings, fascia, plastic trim, etc. These clips attach to ridges, holes, or other features either molded into or adhesive attached to the trim piece. They generally snap into a slot or hole in the substrate metal or material. There are several companies that make nothing but these types of attachment fasteners.

To summarize; while most of the science of fastening utilizes standard parts and functions very well with them, the need for a special part for a special application occurs with regularity. Often a standard part can be customized with little additional cost. The main factor is the required volume. However, when needed, that part, essential to the design, must be produced, whatever the cost. Some ways that special parts are manufactured are as simple as using a low carbon stamped nut formed around an existing nut (examples above) in place of a stamped, high carbon steel part. The cost of a unique U-nut type part is extremely prohibitive unless the volume is in the hundreds of thousands or greater (multi stage stamping dies and progressive operations are the contributing cost factor).

Minor changes to standard parts (head diameter, length, and thread length) are relatively inexpensive. Consultation with manufacturers in the design stage may show that a part that fits the design (or almost) is available with minor effect to the joint function. Often a solution as simple as turning the joint around (looking at the attachment from the other end) may solve the dilemma. The purple rivet discussed was the solution to the problem of the heat shield attachment. No intrusion into the body compartment was allowed but how was the operator to know if all the holes were sealed up? Plugging all the holes with a rivet was cheap and quick but how would it be known that all the holes were plugged? Making them stand out visibly for a quick count was the answer. A custom fastener solution.

