Why Automotive Fasteners Are Special

by Laurence Claus

Figure 1: Example of Seat Belt Anchorage Screw

Figure 2: Example of Brake Caliper Pin

Threaded fasteners and cold formed components are perhaps the most widely utilized of all mechanical components. They are integrally important parts of many everyday machines, devices, and appliances. Although they are available in a wide assortment of sizes and configurations, the majority of such items are purchased by the consuming industry to available industry standards such as ISO, ASTM, ASME and JIS.

It is important to realize that a "standard" part does not infer lesser quality or limited engineering content. In fact, many "standard" parts are exceptionally highly engineered items. One needs only to review NAS Aerospace or ASTM Material Standards to dispel any such misconceptions.

Although most fastener users rely on utilizing parts specified by these industry standards, two industry segments stand-out as exceptions to this practice. They are the automotive and, to a lesser extent, the aerospace fastener industry segment. In these industry segments many of the threaded fasteners and cold formed components are designed especially for specific applications or to perform additional functionality beyond just holding two items together. These are known as "customer proprietary" parts. In fact, greater than 80% of the mechanical fasteners in the automotive industry likely fall into this category.

This article will explore this phenomenon and consider the reasons so many automotive fasteners are uniquely designed by the automotive OEMs.

Reason #1: Automobiles are Complex Systems

The automobile is a little like the human body, a disparate set of parts, working in unison to form a system that performs a desired outcome. In the case of an automobile, the outcome is usually to move its driver and passengers safely and comfortably from one location to another. Like the human body it possesses subsystems which provide power (engine), temperature modulation (cooling and HVAC), transport of signals and instructions from the brain center (electrical), waste expulsion (exhaust) and motion suppression (braking) to name just a few. Each of the subsystems performs its own unique set of outputs and functions which often dictate special requirements for the fasteners they utilize.

Take for example, the anchor screws for seat belts **(Figure 1)**. At first glance, these screws appear to be relatively standard thread rolling screws. Although common-looking in appearance, there is nothing at all common about these screws. They must be able to form threads, achieve high axial loading (so as to not come apart), and possess the mechanical property of toughness so that they will not break if subjected to extreme impact loading as might occur in an accident.

To accomplish this, what might otherwise be a pretty commonplace screw is transformed into a highly engineered specialty fastener. Normally a thread forming screw of this type would receive case hardening treatment. However, to provide the strength in the point area and the toughness in the body area, these fasteners are made of alloy steel, through hardened to HRC33-39 and completed by induction hardening on the point. This unique design combination allows the screw to perform its thread forming function as well as provide safe and effective anchorage for the seat belt. The anchorage function is exceptionally important because in an accident, those buckled-in depend on the seat belt harness attachment point to not break under the influence of a strong impact load, which it would be prone to do if the screw were simply a traditional case hardened, thread forming screw.

In a different example, take brake caliper pins **(Figure 2)**. These are the pins on which the two sides of the brake caliper slide to engage or release the brake. In addition to acting as bolts or screws which help to clamp the caliper halves together, they must be very straight to guide the sliding action of the two halves of the caliper together and apart, be fatigue resistant, provide retention of rubber seals or dust boots, and able to endure high heat. These fasteners are highly specialized and normally require special materials, special hardening processing, secondary machining, and occasionally precision ground surfaces.

As these two examples illustrate, because many automobile subsystems are very specialized and perform unique functions, they are designed with fasteners which contribute more than just clamping to the system's functional requirements. In fact, since each subsystem is unique in its own way, it often dictates why automotive fasteners receive "special" design or process treatment when compared with their less specialized industrial counterparts.

Reason #2: Design Control

Each automotive company tends to do things their own way. That means that even though fastener parts may be performing similar functions in similar systems, the legacy practices or special requirements of one OEM over its competitors will "trump" the use of one standardized approach.

There is no better example of this than the coatings and platings used to protect the parts from corrosion. Each automotive OEM has their own requirements and specifications so that no two automotive OEMS will ever have identical or standardized parts.

Although there are no common standards between OEMs, the automotive companies have realized the value of utilizing standard parts whenever possible across multiple vehicle platforms. To this end, most of the OEMs do maintain their own fastener standards or a standard parts catalog. They encourage designers to use these standards whenever possible, although more often than not, either lack of awareness of these options or special needs such as described in Reason #1 prohibit them from doing so.

Reason #3: Fatigue Rated

Most automotive fasteners are not fatigue rated; however, several very important ones are. Fatigue is a concern in joints exposed to significant dynamic loading from thermal cycling or load reversal. Several common automotive fasteners that are exposed to such loads are engine head bolts, connecting rod bolts, and brake caliper pins.

When fasteners require design for fatigue, they quickly transition from standard to special parts. Fasteners designed for fatigue commonly employ special material, special body configurations, and special manufacturing processing.

Reason # 4: Special Configurations (Geometry)

Many automotive fasteners are more than just headed and threaded fasteners. In fact, the variety of configurations is very impressive and perhaps more widely ranging than in any other industry employing cold headed components and threaded fasteners. Whereas most applications using fasteners employ parts with standard head shapes and thread profiles, automotive fasteners routinely are given unique shapes and configurations.

Figures 3-6 illustrate some of this diversity, where the fastener incorporates special flats, shapes, teeth, etc… Often it takes skilled suppliers with unique capabilities to supply such wide ranging geometries and configurations.

Reason #5: Special Processes

The wide range of automotive fastener configurations is made possible using many different manufacturing processes. While most applications employing fasteners require only standard parts with heads and threads, many automotive fasteners are made with unique and special manufacturing processes. Several of these processes, as examples are grinding, machining, and broaching. These operations give parts special geometries, functional features, and precision dimensions. **Figures 7-9** illustrate representative parts from some of these special processes.

Reason #6: Proprietary Features

Proprietary features or proprietary fasteners are designs employing unique technical know-how and information. The know-how is usually patented or treated as a trade secret by the developer and made available under license agreements to manufacturers or suppliers. Commonly recess drives, special thread forms, and special points are proprietary. **Figures 10-12** illustrate several proprietary features or fasteners commonly utilized in the automotive industry.

The automotive industry is always seeking ways to incorporate new and better technology in their product. For this reason, the automotive industry is probably the largest user of proprietary fasteners or fasteners with proprietary features of all the industries using fasteners.

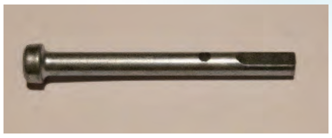

Figure 3: Example of Part With Flat on End

Figure 4: Example of Bent Shank Spherical Head Part

Figure 5: Example of Flattened and Pierced Head

Figure 6: Example of Rectangular Head With Side Nibs

Reason #7: Scope of Fastener Products

Most products that utilize fasteners are relatively limited in the breadth of fasteners used. Even large scale complicated machines and equipment usually do not possess the breadth of fasteners employed in even the most run-of-the-mill automobiles. Automobiles have fasteners of all kinds ranging from the very traditional like screws, bolts, and nuts to the more non-traditional such as self-piercing rivets, flow drill screws, clinch nuts, and plastic fasteners, to name just a few.

Reason #8: Part Volume

One of the unique attributes of the automotive industry is related to the volume of fasteners consumed. Perhaps unlike any other industry, because the number of fasteners used is significant, automobile OEMs can justify designing unique and special parts as opposed to relying on "fitting" a standard into their design. In fact, because of the volume of fasteners used, automotive OEMs and many of their Tier suppliers employ full-time, dedicated fastener engineers.

Conclusion

In conclusion, these are a number of reasons why the automotive industry generates so many unique and special parts. In addition to the complexity and high level of performance, many of these automotive fasteners are expected to achieve multiple tasks or functions. The automotive industry is very demanding regarding quality systems and customer service expectations. All of these factors work together to make automotive fastener suppliers some of the best in the fastener industry. ■

Figure 7: Example of Broached Teeth

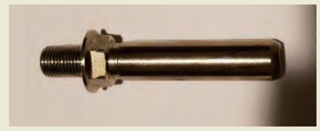

Figure 8: Example of Precision Ground Shaft

Figure 9: Example of Axial and Cross Drilled Holes

Figure 10: Example of EJOT® Delta PT® Proprietary Thread For Plastics

Figure 11: Example of Acument® Torx Plus® Recess

Figure 12: Example of MAThread® Anti-Cross Threading Point