TECHNICAL REPORT

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ONE-TIME FASTENERS

THE LOGIC BEHIND THE TECHNOLOGYY

A “fastener” by definition, is a device that mechanically attaches or connects objects together – in general, a fastener will create a non-permanent joint, in that it can be removed / re-fitted without damaging the joint components.

Traditional autobody fastener methods have included bolts and nuts/machine screws, rivets, clips, and self-tapping screws.

For the most part, screws and clips continue to be the attachment methods of choice for a myriad of cosmetic parts, both interior and exterior. Generally speaking, these are fasteners that can be removed/installed a number of times without affecting the performance of either the fastener, or the attachment site.

In the new age of crash management and occupant protection technology advancements, threaded fasteners, (and to a lesser extent, rivets) continue to be attachment methods of choice for vehicle-makers, especially for structural components and closure panels. What has changed dramatically is the defined performance parameters of threaded and riveted parts ….

One-time fasteners : Rivet usage in the unibody structure / Body-In-White (BIW)

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There have been numerous emergent attachment technologies explored by vehicle-makers in recent times, (apart from welding methods) that by necessity, will be required either because of the negative heat effect of welding processes, or because the components to be attached are made of dissimilar metals (particularly aluminium), and/or composite materials such as GRP and carbon fibre.

In these instances, appropriate joint performance is best achieved by creating a hybrid attachment system, whereby mechanical fasteners are used in conjunction with (structural) adhesives. The combination of these connection methods provides superior performance in both “shear” and “peel” strength, with the additional benefit of NVH (Noise Vibration Harshness) improvements.

The “mechanical fasteners” of choice for most hybrid applications, will be rivets. Irrespective of the type of rivet, all are classed as “One-Time Fasteners “- in that they will be damaged or destroyed in the removal process and will require replacement. Other considerations for rivets include vehicle -maker BRM procedures requiring their use to replace spotwelds, laser welds or other OEM attachment methods that cannot be satisfactorily replicated in the repair process.

The ongoing challenges with using rivets is identifying /selecting the correct rivets required in any given procedure, as many OEM’s either do not provide specific rivet specifications, or the availability of the correct fastener is substantially restricted.

One-time fasteners : Bolt - On applications

Under most circumstances, we think of threaded fasteners as being re-usable – in that we can loosen / remove and re- tighten indiscriminately, without compromising fastening performance. Replacement is deemed to be only necessary should the threads be damaged (stripped) or the bolt has broken / snapped.

Many vehicle – makers now require certain bolt-on fasteners to be replaced if they will be removed in the repair process -especially in high-load situations such as crash management componentry and structural parts. The question that often gets asked is why this is required, as even a close examination of the removed fastener, does not display any visible compromise (of the thread, in particular).

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Threaded fasteners that require replacement are determined by one of two OEM specifications - either: -

- **Torque Sensitivity**
- **Corrosion Inhibiting**

Torque Sensitive: -

Also commonly called “Torque to Yield (TTY)” or “Stretch Fastener” – both terms accurately describing what occurs when the fastener is originally installed –

To explain this more accurately, if we look at conventional threaded fasteners, they will display a change in the interface between the threads of the bolt and nut assembly when tightened or torqued to a specification. This is called **Elastic Deformation**, and is required to create a pre-load, or clamping force. Elastic deformation is not a permanent change and allows the fastener to re-used / re-torqued.

With TTY fasteners, the torque sequence creates **Plastic Deformation** of the thread interfaces – this generates a higher pre-load that significantly increases the fatigue strength of the fastener and is extremely beneficial for higher load / strain applications, as well as allowing for smaller fasteners to be used. The disadvantage with the plastic deformation process is that it is permanent – the fastener will not be able to be re-torqued to its original specification once it has been loosened – requiring its replacement.

Corrosion Inhibiting: -

As previously identified, joining dissimilar materials often requires the utilization of specialized attachment methods. A further consideration for joining mixed metal parts (steel to aluminium in particular), is the fact that direct contact which occurs in the fastening process can create a reaction between the different metals – this is described as “Galvanic Corrosion”.

To avoid this reaction occurring, a “barrier” or separation process is required. This can be achieved by either using isolation devices like sealing washers or sealing strips between the mating surfaces, or more predominately, coating threaded fasteners with a corrosion inhibiting material.

Steel fasteners to aluminium: -

- **Uncoated (left)**
- **Coated (right)**

The coating applied to threaded fasteners goes by the trade name of Dacromet – this is a zinc rich coating program applied at the point of manufacture. Traditionally, this coating was silvery - white in colour, but is now available in other colors including black, red, blue, green and yellow to identify specialist applications, and is sometimes mistaken as a thread-locking compound.

Dacromet-coated fasteners typically require replacement after removal, as the zinc layer (which cannot be reinstated) is damaged, compromising the corrosion prevention barrier between the dissimilar metals, if reinstalled.

Dacromet coated bolts: -

- **Damaged coating (left)**
- **Undamaged coating (right)**

These articles have been written by Martyn Lane: I-CAR Instructor, Weld Test Administrator and Technical Specialist to the auto body industry