STAINLESS STEEL FASTENERS FEATURE

Why use stainless steel fasteners?

By Tim Collins, secretary general, worldstainless

Most people are familiar with fixings and fasteners of some form, whether they are bolts, screws, furniture fittings or even pipe fittings. Equally many people are able to use fixing products with relative ease. However, how often do we consider the suitability of the type of material that fixings and fasteners are made from? Equally, do we routinely consider if we are using fixings products appropriately?

When using and working with metal and alloy installations, such as fixings and fasteners, there are some critical rules that should always be followed in order to avoid unwanted outcomes. These unwanted outcomes typically range from a need for additional maintenance work to failure of installations.

The critical rules primarily fall into three categories:

1. Rules to prevent galvanic corrosion.
2. Rules to prevent crevice corrosion.
3. Rules to avoid severe thread galling.

Whilst stainless steels may not be considered as the material of choice for fixings and fasteners, the use of stainless steels in a holistic manner for both installations and fixings overcomes many costly problems. Stainless steels offer some unrivalled benefits (beyond their corrosion resistance). High strength grades allow for 25% - 30% reduction in total weight needed and lifecycle costing shows stainless steels are generally more than 25% cheaper when compared to alternative material choices. This benefit results directly from avoiding regular maintenance and repairs, which are frequently associated with suboptimal material choices and the above categories.

Taking a closer look at the three categories already mentioned, highlights why stainless steels are a compelling material choice.

Galvanic corrosion

Galvanic corrosion is damage that occurs when two electrochemically different metals are in electrical contact with a conducting electrolyte present. An electric current flows between the two in-contact metals with the electrolyte, such as a liquid, enabling the current flow. We can use a very simple galvanic corrosion table to illustrate what can go wrong with material being classed as 'most noble', resist galvanic corrosion, and 'least noble', preferentially corrode galvanically .

Figure One shows that metals and alloys can safely be in contact with other metals and alloys. The colour coding provides helpful guidance – with the green boxes representing the perfect materials pairing. Other pairings should be avoided. »

Galvanic corrosion

	Least Noble					Most Noble	
	Zinc	Galv C-Steel	Aluminium	C-Steel	Cast Iron	Brass	Stainless
Zinc	0mV						
Galv C-Steel	0mV	0mV					
Aluminium	310mV	310mV	0mV				
C-Steel	400mV	400mV	90mV	0mV			
Cast Iron	400mV	400mV	90mV	0mV	0mV		
Brass	750mV	750mV	440mV	350mV	350mV	0mV	
Stainless	1150mV	1150mV	840mV	750mV	750mV	400mV	0mV

Figure One: Simple galvanic corrosion table

For example, a zinc fixing in contact with a galvanised carbon steel corrugated sheet is perfectly ok as no electrical current will flow. On the contrary a zinc fixing in contact with a stainless steel corrugated sheet is never ok as in this case the zinc fixing will corrode quickly and the stainless steel sheet will then become unsecured. The differences in the created galvanic potential, electrical current flow are expressed in millivolts (mV). The larger the figure the faster corrosion occurs.

Stainless steel installations should always be secured with stainless steel fixings. It is not unknown for a stainless steel urinal to fall to the floor because carbon steel or galvanised fixings were employed.

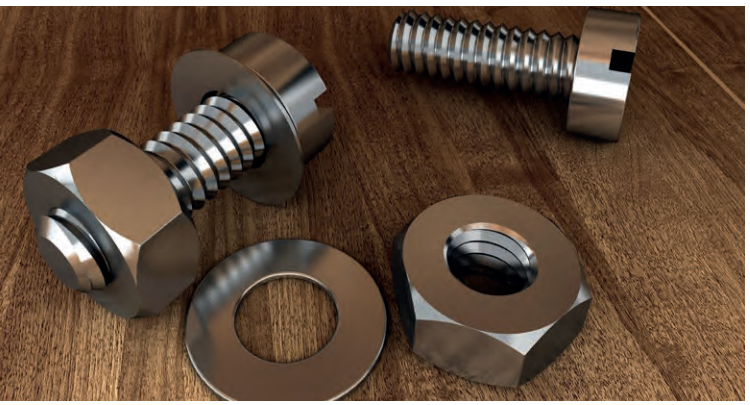
Crevice corrosion

A crevice is a confined space, examples of which include gaps in, and contact areas between, material parts, spaces under gaskets and seals, and spaces filled with deposits. When dust, sand and other substances are deposited on surfaces this creates an environment where water will accumulate. It can happen between two metals or between a metal and a non-metal. Corrosion is initiated by the creation of a chemical concentration gradient.


Crevice corrosion

Crevice corrosion can be prevented by optimising the product or component design. This includes minimising joints with fixings as far as is practical and designing joints in a manner that will allow for complete drainage of liquids. Furthermore, regular cleaning of crevices will remove deposits and thereby eliminating the likelihood of initiating crevice corrosion.

Selecting a suitable corrosion resistant material for the operating environment is also an important consideration. Always remember that coatings on metals and alloys will ultimately fail if you choose coated materials – whereas stainless steels will consistently provide the optimal corrosion resistance.



Thread galling

Thread galling is primarily associated with fasteners made of stainless steels, aluminium and titanium, known as the 'passive film' metals and alloys.

Galling occurs when excessive pressure is used to tighten a nut onto a thread. It can result in the complete welding of a nut and bolt together. Excessive pressure increases friction between the mating threads. In the extreme, thread galling leads to seizing of the threads and if tightening is continued, the fastener can be twisted off and sheared.

Machined threads and fine threads are most susceptible to galling because they are less durable when compared to rolled threads. Thread rolling is the preferred method for producing strong, smooth, precise and uniform threads.

Slowly tightening nuts solves the problem. Furthermore, using slightly different alloy grades for the bolt and the nut reduces galling, as the materials have slightly different hardnesses. If, for example, a bolt is A4 (stainless steel 316L) and the nut is A2 (stainless steel 304l) they are less likely to gall than if they are both the same grade – because the different alloys work harden at slightly different rates.

In conclusion

Fixings and fasteners are important components in all installations. These products should never be an arbitrary choice to fix something or complete a piece of work. Material selection is vitally important to avoid costly future problems.

Fixing and fastener materials should always be the same material type as that of the primary installation in order to avoid galvanic corrosion. Product design is also important to avoid the creation of crevices or minimise the effect of crevices by ensuring that they can be cleaned easily and will drain any liquids away effectively. As well as this, choosing fixings with rolled threads and not machined threads will reduce the likelihood of any thread galling problems, which can lead to fixing failures.

Choosing stainless steels for both the product and the fixings materials will deliver many desirable benefits, including a lower lifecycle cost of at least 25%; a lower lifecycle emissions profile of some 40%+; as well as an almost maintenance-free installation.

About worldstainless

worldstainless is a not for profit research and development association that was founded in 1996 as the International Stainless Steel Forum. Its vision is to sustain the world's future with stainless steels. +

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