WHAT IS HYDROGEN EMBRITTLEMENT RISK?

Hydrogen embrittlement is generally associated with high-strength fasteners made of carbon and alloy steels. Hydrogen embrittled fasteners or parts under stress can fail suddenly without any warning.

WHY DOES HYDROGEN EMBRITTLEMENT OCCUR?

Hydrogen embrittlement can occur at the atomic level when hydrogen is produced from a reaction, e.g. acid pickling will diffuse hydrogen in iron. Electroplating is another process that can introduce hydrogen into a metal in both the acid pickle and the plating processes.

Hardness is a major contributor to hydrogen embrittlement. Harder, stronger materials are more susceptible to failure than weaker, softer ones. In general, if the hardness of the fastener is less than 35 HRC, there will probably be little difficulty with hydrogen embrittlement. However, if the fastener has hardness above 40 HRC, problems are more likely to occur. Hydrogen concentration is another factor that contributes to hydrogen embrittlement. Coating processes such electroplating can introduce hydrogen during the acid cleaning stage. During this stage, the material to be plated is immersed in an acidic solution. Higher acid concentrations and long exposure times will increase the hydrogen concentration in the fastener material, thus increasing the likelihood of hydrogen embrittlement.

In order to avoid/reduce the risk of fracture, you must perform a de-embrittlement process (baking) within 4 hours. However, for fasteners with a hardness ≥40HRC, a de-embrittlement process cannot guarantee the risk of fracture is ruled out. Hence Thomas Warburton will not supply 12.9 zinc plated fasteners to our customers (effective 1 January 2017).

WHAT ARE THE ALTERNATIVES?

Using a coating process that does not introduce hydrogen into the material (particularly those that do not utilize acids for cleaning) will help avoid this problem. A number of dip-spin coatings are considered hydrogen embrittlement “free” because they use mechanical processes (abrasive blasting) for descaling. The other option is to use a fastener which is of a lower hardness. After thorough market analyses the following alternatives can be offered: 12.9 Geomet® and 10.9 Zinc.

NOTE

These solutions are for metric dimensions only. For imperial dimensions, please consult with the Thomas Warburton.

12.9 GEOMET®	Type of Surface Protection	Features	Limit values for the coefficient of friction (μ) according to DIN EN ISO 16047	Nominal Thread Size	Reference Coating Thickness (μm) 2)	Test according to DIN EN ISO 9227-NSS(h) 3)	Compatible with Property Class
GEOMET® 321A VL 	• Zinc flake coating • With organic/ anorganic top coat • Colour: Silver • With lubricant for torque tension adjustment	• “High” corrosion protection • For exposed installation positions and/or high-strength fasteners • Fits with automotive standards	0.09 – 0.14 1)	≥ M6	min. 5	480 RR	up to 12.9 (incl.)

10.9 Zinc	Type of Surface Protection	Features	Limit values for the coefficient of friction (μ) according to DIN EN ISO 16047	Nominal Thread Size	Reference Coating Thickness (μm) 2)	Test according to DIN EN ISO 9227-NSS(h) 3)	Compatible with Property Class
Zinc Cr3+ 	• Electrolytic Zinc Plating • with Cr3 passivation • Colour: Blue	• “Standard” corrosion protection • For indoor use or non aggressive zones	0.14 – 0.24 4)	≥ M2.2	5	48 RR	up to 10.9 (incl.)

1) The friction value range is adjusted by additionally applied lubricants or lubricants integrated in sealing systems
2) Reference coating thicknesses: The result of the corrosion test is decisive for the assumed value
3) RR = Base metal corrosion (red rust)
4) Theoretical values (Source: VDi 2230) often lower in practice: around 0.14 to 0.18