Layers of Protection
Our Mission

- To revolutionize bolt theory and practice in the fastener industry.
- To provide unparalleled cost savings and improve worker safety through the elimination of costly and dangerous procedures.
- To consistently conceptualize and deliver safer, less expensive, and more scientifically sound bolting to the industry.
The Swiss Cheese Model

- Risk management principle based on defense in depth that prevents potential risks from becoming reality.
- Mitigates any single point of weakness that could compromise the system.
API 20E Specification

- In 2012, API published Specification 20E to create a better standard for alloy and carbon steel bolt production.
- We verify that the steel is manufactured following API 20E Bolting Specification Levels (BSL) 1, 2, and 3.
Reduction of **Base Material Hardness**

- We check Hardness of the material following the API 20E
- Materials with a hardness lower than 34 HRC are less susceptible to hydrogen induction than harder materials.
Elimination of All Sacrificial Coatings

• Many coatings are designed to corrode in place of the steel that they coat. As they oxidize, hydrogen is produced that permeates in the bolt and may cause hydrogen embrittlement.

• Our Nickel-Cobalt plating is not sacrificial, so it does not produce hydrogen.
**ASTM B994 SC18 Class 1**

- Oversizing of the nut threads or under sizing of the bolt threads is not permissible by API 20E.
- Electroplating using Nickel-Cobalt alloy as specified by ASTM B994 SC18 Class 1 guarantees the thickness does not require oversizing or under sizing of the threads.
Baking the Fasteners

- We follow the API 20E requirement to remove Hydrogen from plating.
- Following ASTM B850 ER9, we bake all electroplated parts within 2 hours after plating for 8 hours.
API 20E requires that the electroplating process did not induce hydrogen in the material every 60 days according to ASTM F519.

We verify by ASTM F519 every 30 days.
Packaging

- The Doxsteel Fasteners Packing System protects the integrity of threads and helps maintain consistent $k$-factor.
- A dent in a bolt’s thread can have a 30% effect on its torque value. Doxsteel Fasteners Packing System eliminates the risk of dented parts.
**k-factor Consistency**

- The Doxsteel Fasteners Nickel-Cobalt Plating maintains a consistent low coefficient of friction.
- Through testing, we have obtained a $k$-factor to calculate the torque needed based on the clamping load requirement.
- Consistency in $k$-factor reduces the possibility of over or under torquing/loading the bolt.
A Barrier to Hydrogen in the Field

- Hydrogen produced through cathodic over-protection will not penetrate our Nickel-Cobalt coating and will not reach the base-material.

- There is no hydrogen permeation in Nickel-Cobalt.
Cathodic Protection of Steel

- The barrier effect does not affect or interfere with the cathodic protection applied to the base material.
- Nickel-Cobalt is an excellent electrical conductor. It maintains the continuity of the cathodic protection system.
Conclusion

• Multiple layers of protection maintain bolt integrity both in the lab and in the field.
• API 20E specifications provide multiple layers of protection, including rigorous testing methods and protection from hydrogen embrittlement.
• Consistent manufacturing and coating processes keep k-factor consistent.
• The Doxsteel Packaging System makes installation safer and easier.

When compared to other fastener companies, the difference is clear. Doxsteel Fasteners are the safer, more cost-effective, and scientifically proven solution to critical bolting operations.
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