MTC SOLUTIONS

Advances in Self-Tapping Wood Screws: Navigating New Standards and Understanding Hydrogen Embrittlement

Online Learning Session Q&A

During our recent webinar, *Advances in Self-Tapping Wood Screws: Navigating New Standards and Preventing Hydrogen Embrittlement*, we received a number of insightful questions from attendees. These questions touched on critical aspects of mass timber construction, including fastener selection, hydrogen embrittlement prevention, and practical applications of the updated standards in CSA O86:24.

To ensure these discussions continue to provide value, we've compiled a document featuring these questions (and their answers), offering additional clarity and guidance on the topics covered during the session. Whether you attended the webinar or are exploring these subjects for the first time, this resource aims to address some of the most common technical queries in the field.

Can we test Hydrogen Embrittlement (HE) with regular mechanical testing, such as bending the screw?

No. To check for HE, you need a sustained tension load applied over an extended period to let the hydrogen migrate from all over the screw to the greatest stress concentration. Most mechanical tests are completed too fast for this process to occur.

Can an otherwise ductile steel fail brittle due to HE?

By definition, HE is a permanent loss of ductility. However, if an otherwise ductile steel is exposed to enough hydrogen, under sufficient sustained load it may become brittle due to HE, and therefore it would no longer be ductile where it is critical.

What is the difference between corrosion rating and the possibility to use a screw without HE risks?

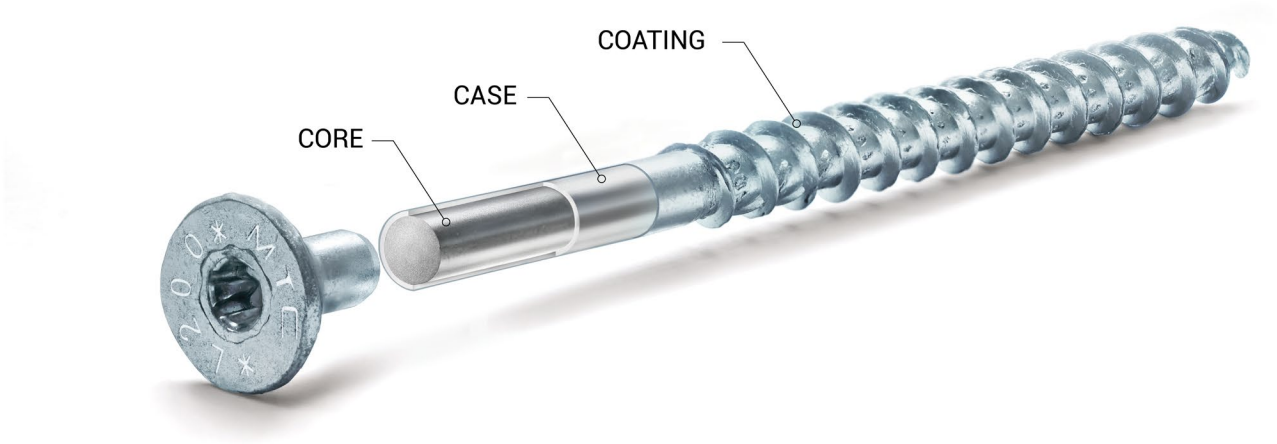
The corrosion rating of a screw is measured by a salt spray test. This only checks the amount of time a screw can resist a salt spray test before corrosion is detected. The results of this test are independent of HE. Corrosion resistance is a durability measure while HE control is a strength and ductility measure. Corrosion can lead to hydrogen generation and hydrogen absorption into the steel, potentially leading to HE.

Can you give more details about what a delayed failure means?

A delayed failure occurs after the installation of the screw is complete and the drill is no longer engaged. In many cases this is within hours of installation or within hours of the screw being subjected to a sustained tension load of a certain magnitude.

Why do you say core hardness, and what does it mean?

A carbon steel self-tapping screw is a case-hardened screw, which means it has a harder outer shell and a softer core. This is by design so that the harder case resists the installation torque and cuts through the wood, but the inner core is more ductile and can resist lateral and axial loads better. For HE, we talk about the core hardness because this is where the screw is expected to be ductile. The harder outer case is expected to be harder with a hardness above 450 HV. The image below shows where on a screw we are referring to when we say core hardness.



How can I receive the specs you mentioned regarding HE?

Please reach out to our Technical Support Team at support@mtcsolutions.com.

Is there any intersection between HE and fatigue loading?

The overlap between these two failure modes is that they can both cause a screw to fail below its ultimate tensile strength (UTS). Typically, fatigue loading is cyclic in nature, means it doesn't provide sustained tensile stress—one of the necessary conditions for HE to occur.

Does HE apply only to fasteners, or can it also affect plates, angles, etc.?

It affects any steel but is more prevalent in electroplated hardened steel products, like self-tapping screws.

Is there a field test, such as a bend test, that we use with headed studs and welds in steel?

Not currently. The test requirements for HE require specialized equipment that must be set up in a stable, climate-controlled environment where the steel is subjected to sustained tension loading.

Where is the failure typically occurring on screws affected by HE? Does it happen at a specific point on the screw?

Typically, failure will occur where the stress is the greatest, such as a stress concentration. In a self-tapping wood screw, this is commonly under the head or the first thread. This would be the case for almost all steel-to-wood connections. A special situation can occur in wood-to-wood connections with fully threaded fasteners where the greatest stress can be at the interface of the two members. In general, a HE failure can occur anywhere along a screw if the conditions are right.

Can Environmental Hydrogen Embrittlement (EHE) occur within just a few days?

For EHE to occur within a few days after installation, a significant amount of hydrogen exposure would have had to occur. The most common source of hydrogen in the field is from corrosion and moisture, so the conditions to achieve an EHE failure a few days post-installation would be extreme corrosion. The most common delayed failure within a few days, assuming HE has been determined, would be Internal Hydrogen Embrittlement (IHE).

We hope this document provides you with helpful insights and actionable information. If you have additional questions or require more technical support, our team is here to assist.

👉 Contact Technical Support to connect with our experts.

Looking for more detailed guidance? Don't forget to check out our Structural Screw Catalog, updated with the latest standards in CSA O86:24, featuring comprehensive design formulas, performance specifications, and installation guidelines for mass timber connections.