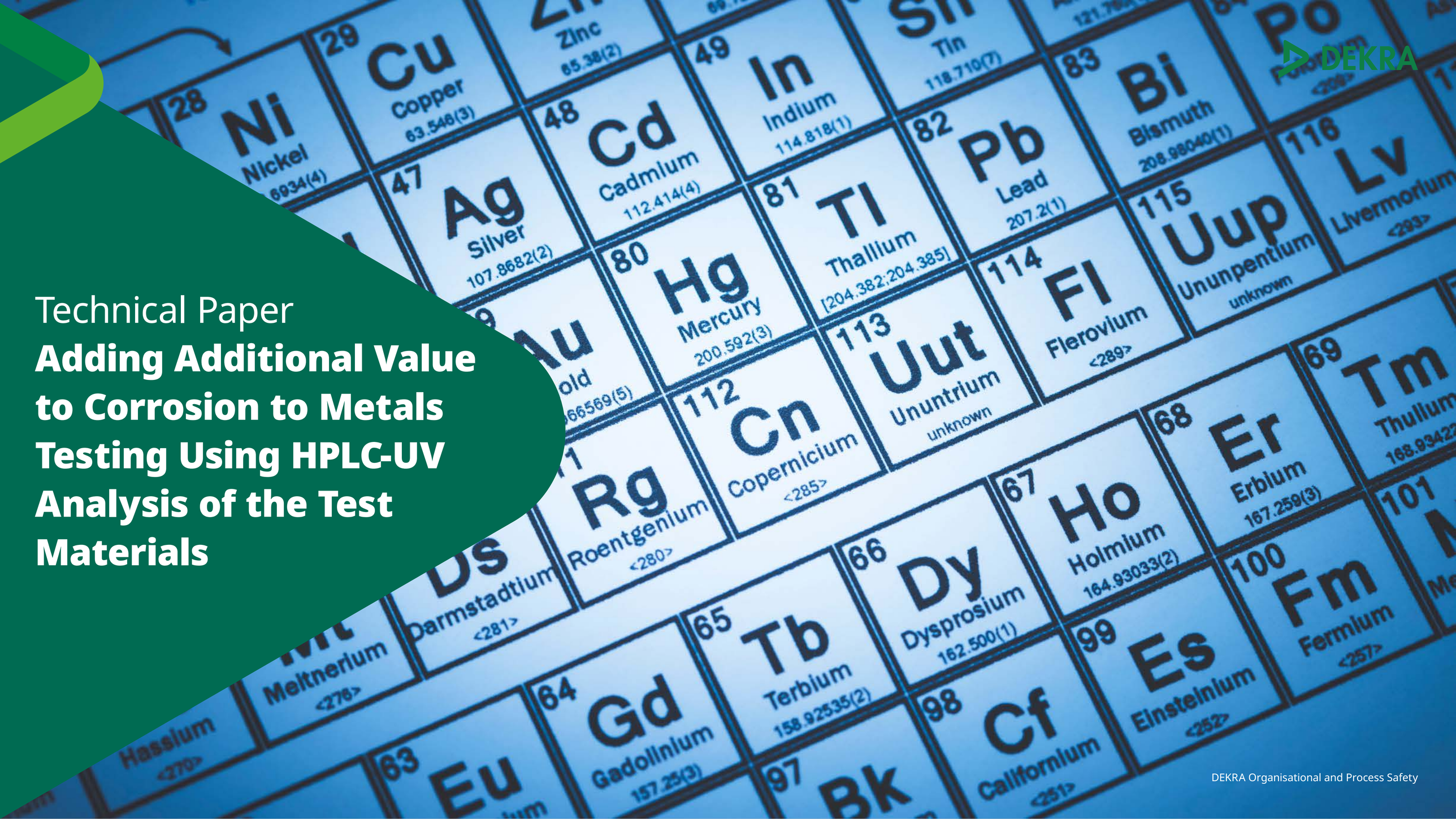
Technical Paper

# Adding Additional Value to Corrosion to Metals Testing Using HPLC-UV Analysis of the Test Materials




DEKRA Organisational and Process Safety

DEKRA can enhance **corrosion testing** with **HPLC-UV**, providing deeper insights and greater accuracy in **material interactions** and **compliance**.


**Abstract**

Corrosion to metals testing is a critical requirement for ensuring the safe transport of goods, as mandated by regulations such as the UN Transportation of Dangerous Goods Recommendations, GHS, IMSBC, and various EC regulations. Standard testing typically involves immersing steel and aluminium coupons in a test material at 55°C for up to 28 days, assessing changes in appearance, corrosion effects, and mass loss. However, due to the complexity of corrosivity, multiple factors such as ingredient interactions and decomposition can impact the test results. To enhance the standard test, high-pressure liquid chromatography with ultraviolet detection (HPLC-UV) can be used to analyse the organic components of the test material.

This method allows for the detection of compositional changes throughout testing, offering insights into the material's behaviour with metals and other materials. Although not required by regulation, HPLC-UV adds significant value to corrosion testing by tracking any chemical changes, improving the accuracy and reliability of the results.

**Corrosion testing** on metals is conducted to ensure materials meet **safety** and **regulatory standards.**

Corrosion to metals is a key test needed to ensure the safety of goods during transport. Information on the corrosivity to metals of a material is required by the UN Transportation of Dangerous Goods Recommendations (Class 8, Packing Group III) and the Globally Harmonised System for Classification and Labelling of Chemicals as well the International Maritime Solid Bulk Cargoes (IMSBC) and EC Regulations (EC) No 1272/2008 (Classification, Labelling and Packaging), (EC) No 1107/2009 (Plant Protection Products) and (EU) No 528/2012 (Biocidal Products).

At DEKRA, we have comprehensive knowledge of relevant regulations and their practical application, ensuring materials meet all compliance requirements. Our extensive experience includes conducting corrosion testing on metals for a broad spectrum of materials, tailored to satisfy diverse regulatory standards.

Standard corrosion to metals testing is performed using steel and aluminium coupons which are both fully and partially immersed in the test material and suspended in the vapour phase above (*See image 1*). The testing is performed at 55°C for 7, 14, 21, or 28 days. Any changes to the coupon's appearance are noted, and any corrosion such as the formation of intrusions on the surface of the coupons and mass loss are measured (*See image 3 and 4)*. This provides valuable information on the effect of the test material on steel (*See image 3*) and aluminium (*See image 4)*.

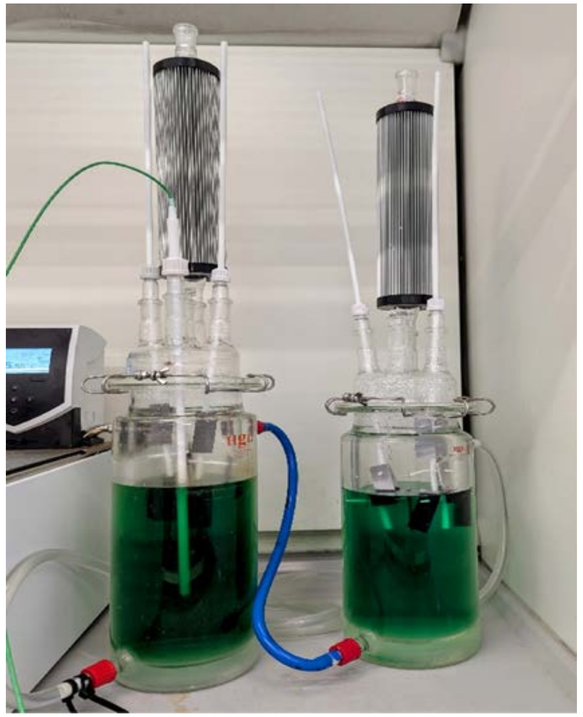


*Image 1. Corrosion testing of a material with steel and aluminium coupons.*

**Corrosivity testing** evaluates **metal degradation** and **variability** due to substance interactions and stability factors.

Standard corrosivity testing is only concerned with the effect of the test material on the metal or other coupon types (*See image 2*). However, corrosivity is complex, as a multitude of factors may impact the corrosion properties of a substance. It's essential to account for the stability of the substance and its active ingredients throughout the testing period. Interactions between ingredients, the formation of reaction products, and the decomposition of components can all contribute to variability in the data.

*Image 2. Non-standard metals coupons. From left to right: Mild, steel, brass, and Hastelloy.*

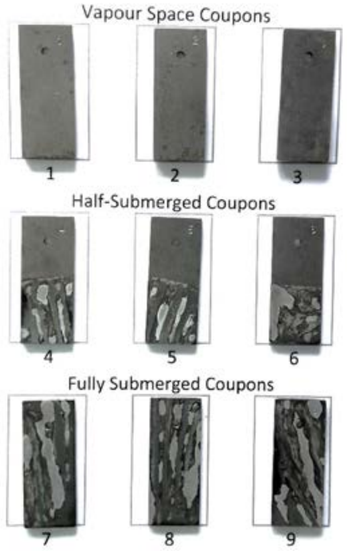



*Image 3. Steel coupons after corrosion testing. The half-submerged and fully submerged coupons all show clear changes to the surface of the metal where it was in contact with the test item. But what about the test item itself?*

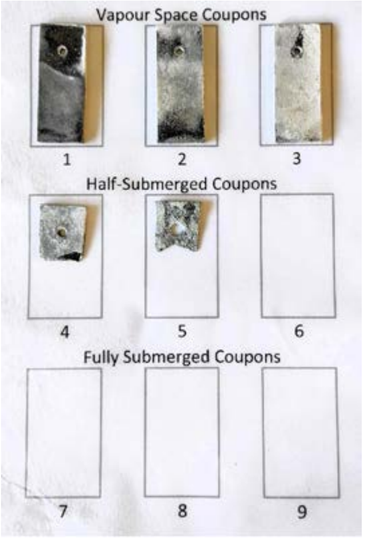



*Image 4. Aluminium coupons after corrosion testing showing complete corrosion of all submerged portions, and a significant effect on the coupons suspended abote the test item level.*

**HPLC-UV** detects and tracks changes in test material composition during corrosion testing analysis.

Going beyond the standard corrosion test, one method of determining if there have been any changes to the composition of the test material is using high-pressure liquid chromatography with ultraviolet detection (HPLC-UV) to analyse the organic components.

HPLC-UV can be used to separate and detect the individual UV absorbing components of the test item and determine their relative, or absolute concentrations (*See image 5*). Determining the composition of the test material before, during, and after corrosion testing allows any changes to the composition to be accurately tracked over the course of the testing. This includes increases or decreases to the concentration of individual components, the appearance of additional compounds not present in the initial test material, or confirmation that the make-up of the test material is unchanged by the end of the testing (*See image 5*).

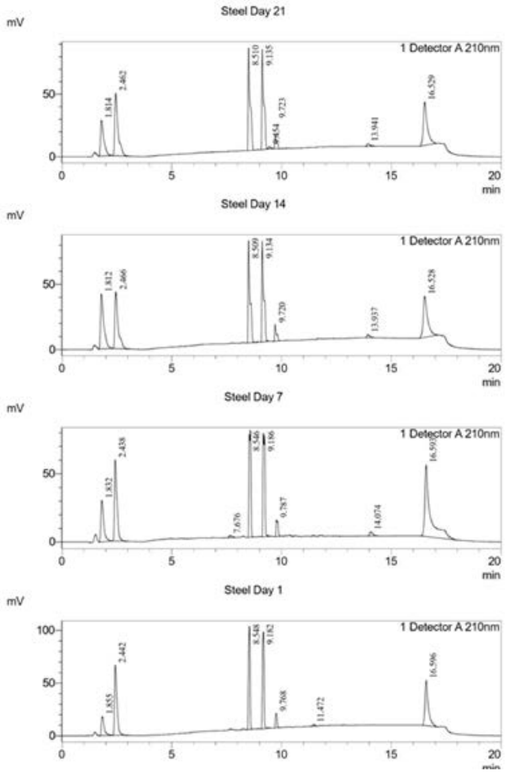



*Image 5. HLPC-UV analysis of a test item from a corrosion to metals test with steel coupons. The chromatograms show that over the 21 days there is little to no change to the active ingredients in the test item (Three peaks between 8 and 10 minutes).*

**Corrosion testing** ensures safety in material transport, with **HPLC-UV** providing enhanced insights on the interactions of the test material.

Corrosion of metals testing is required for regulatory purposes to ensure safety when transporting and labelling materials. Although not part of the standard test, HPLC-UV analysis of the organic components significantly enhances the value of corrosion testing. It offers valuable insights into how a material may be interacting or changing when in contact with steel, aluminium, other non-standard metals, or even non-metallic materials.

Author: Thomas R. Sutton, Senior Analytical Chemist

Peer Reviewed: James Bellows, Laboratory Manager - Regulatory Testing Laboratory
Shajad Ali Younis, Technical Manager - Regulatory Testing Laboratory

# DEKRA Organisational & Process Safety **Contact**

DEKRA Organisational and Process Safety are a behavioural change and process safety consultancy company. Working in collaboration with our clients, our approach is to assess the process safety and influence the safety culture with the aim of making a difference.
In terms of behavioural change, we deliver the skills, methods, and motivation to change leadership attitudes, behaviours, and decision-making among employees. Supporting our clients in creating a culture of care and measurable sustainable improvement of safety outcomes is our goal.
The breadth and depth of expertise in process safety makes us globally recognised specialists and trusted advisors. We help our clients understand and evaluate their risks, and we work together to develop pragmatic solutions. Our value-adding and practical approach integrate specialist process safety management, engineering, and testing. We seek to educate and grow client competence in order to provide sustainable performance improvement. Partnering with our clients, we combine technical expertise with a passion for life preservation, harm reduction and asset protection.
We are a service unit of DEKRA SE, a global leader in safety since 1925 with over 48,000 employees in 60 countries and five continents. As a part of the world's leading expert organisation DEKRA, we are the global partner for a safe world. We have offices throughout North America, Europe, and Asia.

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