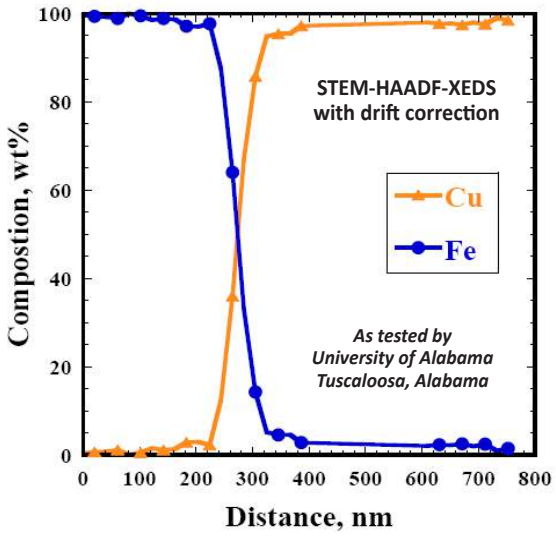
CORROSION INFORMATION (PRO-TRACE CCS)

1. What happens if a gouge, nick, or cut (holiday effect) penetrates through the PE jacket and copper cladding, and exposes the steel core? Are there any potential galvanic corrosion concerns?

NO. The definition of galvanic corrosion can be simply stated as: *Whenever dissimilar metals are in the presence of an electrolyte, a difference in electric potential is developed between the two. One becomes the Cathode and the other becomes the Anode.* The anode will corrode while the cathode will basically remain unchanged. The key and most important point within this definition is: "*in the presence of an electrolyte*". When metals are mechanically fastened together, there remains very small gaps between the surfaces where rain water and dissolved mineral salts can form an electrolyte. This creates an electrolytic cell and galvanic corrosion will occur based on the electromotive series. For example: Steel is above copper in this series and steel would corrode to protect the copper.

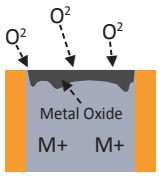
In the case of **Metallurgically Bonded**, Copper Clad Steel, the copper (cathode) completely covers the entire circumference and is metallurgically bonded to the steel (anode). Metallurgical bonding of the copper to the steel core assures that there are no gaps between the dissimilar metals. This means that the molecules of copper and steel are dispersed in one another at the interface. Copper does not form an alloy with Iron or Steel, metallurgical bonding can be considered as a forging where the metals have been heated and beaten into each other. All PRO-TRACE wires are made with Metallurgically Bonded CCS. (***Not Electroplating***)

METALLURGICAL BOND OF CCS

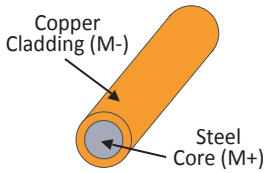


Corrosion of the steel core requires oxygen to migrate to the anode's surface and react. Therefore, an electrolytic cell can only form at the cut end when exposed to an electrolyte. This reaction continues until the total surface area is covered with a thin oxide (or scab), and once formed, prevents further migration and corrosion. In simple terms, the corrosion process stops itself. (See Figure 3)

Steel Core (Anodic) Forms Thin Oxide Then Stops



Cathodic Metal Clad to Steel Core (Anodic)



Since the early 1900's, Copper Clad Steel wire has been used for open telephone lines, power transmission, service drops, utility grounding, and ground rods. The majority of CATV coax has a center conductor of copper clad steel. Bare Copper Clad Steel is heavily used by electrical utilities and has stayed corrosion free for 40 plus years in very harsh environments and is still in service today.

In the case of the copper cladding becoming "breeched" and exposing the steel core, the same holds true. The copper would also flow into the gouge or nick minimizing the area of exposed steel. You see this same effect when you cut the wire. The cladding process uses solid strips of oxygen free copper that is forged into the surface of the steel core. This bond makes it impossible to strike the wire with a shovel or hatchet exposing the steel core. The bond is so well integrated into the surface it simply flows in to the impacted area. This is easily seen in figure 4 and 5. The copper will continue to protect and cover the steel core.

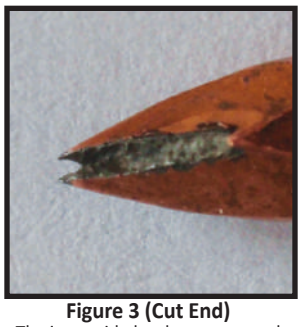


Figure 3 (Cut End)
The iron oxide has been removed mechanically to expose the steel core after 7yrs exposure to normal weather conditions

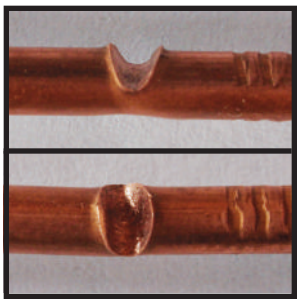


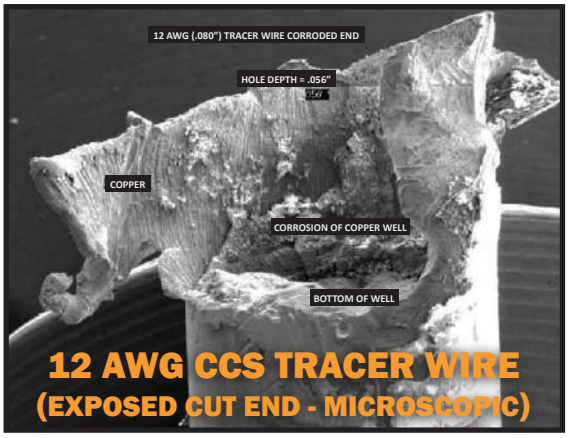
Figure 4 and 5 (Gouge/Nick)
Using a hatchet, a large gouge was created, passing the diameter's midpoint. Smaller gouges created with shank. Steel is not exposed and copper flows over.

Corrosion concerns are being exaggerated by those who do not understand the technology of the cladding process used in manufacturing PRO-TRACE CCS tracer wire. When comparing CCS in cost and performance it is the most viable solution for tracer wire applications. Its corrosion resistance is equal to copper.

The samples used in figure 3 is a 21% CCS and has been exposed to normal weather conditions outside for the past 7 years. Normal weathering is defined as being exposed to the elements of rain, sun, snow and fog. Periodically the sample was inspected and photgraphed to document any changes. The sample is then placed outside to weather.

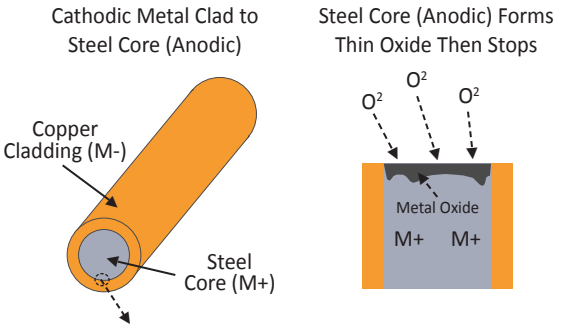
Corrosion Test Information

- **Five year corrosion study was initiated using destructive and non-destructive test along with microscopic analysis to evaluate.**
- **Samples were buried in various soil conditions with monitoring systems to check soil PH, moisture, conductivity and temperature.**

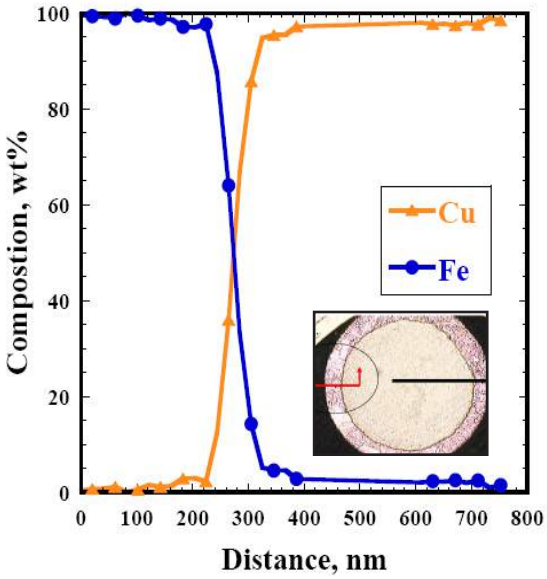


Corrosion Tests Support Our Claims

- PRO-TRACE® HF-CCS & HDD-CCS are corrosion resistant tracer wires.
- Exposing the steel core does not compromise tracer wire performance.
- Depth of Corrosion = 0.056" at which point rust scabs formed sealing out moisture and effectively ceasing the corrosion process.



METALLURGICAL BOND OF CCS



STEM-HAADF-XEDS with drift correction
As tested by University of Alabama
Tuscaloosa, Alabama

PRO-TRACE® CCS TRACER WIRE
Corrosion Information

Specification Updated: 10.30.2010 10:25:44 CST

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