

Types of Epoxy-Coated Reinforcing Steel

by Dr. David McDonald, Epoxy Interest Group

Epoxy-coated reinforcing steel is commonly coated to meet ASTM A775/A775M, "Standard Specification for Epoxy-Coated Steel Reinforcing Bars." Bars meeting this standard are commonly green in color. The second most common standard for epoxy-coated reinforcing steel is ASTM A934/A934M, "Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars." Bars meeting ASTM A934 are typically purple in color. So, why are there two types of products?

Epoxy-coated reinforcing steel was initially evaluated by the National Bureau of Standards (now the National Institute of Standards and Technology) and the first use of epoxy-coated reinforcing steel was in a bridge in Pennsylvania in 1973. In 1981, ASTM A775 was developed for these bars. This early specification only required bars to be bent to 120 degrees without the coating cracking as part of the quality-control procedures. The coatings would occasionally crack if bent more 120 degrees during fabrication, thus requiring the cracks to be repaired.

Research conducted in the 1990s found that the corrosion performance of epoxy-coated reinforcing steel was highly dependent on the manufacturing process, and during the 1990s, specifications were significantly improved to require coatings to pass 180-degree bending without cracking. Additional criteria were added to the ASTM specifications that increased coating thickness and required appropriate surface roughness and bar cleanliness prior to coating. In 1991, the Concrete Reinforcing Steel Institute (CRSI) implemented a voluntary Epoxy Plant Certification Program, which evaluated the ability of plant staff, equipment, and manufacturing processes. Prior to introduction of the CRSI program, backside contamination—a measure of steel cleanliness—would range from 10 to over 60%, but after certification the values were reduced to generally less than 20%. This improvement in cleanliness and assured surface roughness, along with modifications to coating chemistry, led to coatings that were more robust during fabrication.



ASTM A936 reinforcing steel used in the San Francisco - Oakland Bay Bridge. Photo: Caltrans.



ASTM A775 reinforcing steel being placed for the Willamette River Bridge in Portland, Ore. Photo: Harris Rebar, Auburn.

In parallel with the changes occurring in the 1990s for epoxy-coated bars meeting ASTM A775, the Federal Highway Administration and the U.S. Navy recognized the potential for problems with cracked coatings. It was suggested that the problem of coating cracking during bending be mitigated by fabrication of the bars prior to coating. In 1994, Douglas F. Burke wrote an article titled "Epoxy-Coated Rebar in Marine Concrete." This article¹ described construction of a new submarine pier at Pearl Harbor using prefabricated epoxy-coated steel reinforcing bars in accordance with a Naval Facilities Guide specification. ASTM A934 was issued in 1995.

There have been a few side-by-side research programs comparing the performance of bars meeting ASTM A775 and A934. These studies, typically conducted on deliberately damaged bars simulating jobsite damage, have not found substantial differences in corrosion performance for bars meeting either of the two specifications. As bars meeting ASTM A775 are frequently cut after coating, the ends of these bars are required to be patched. Suppliers of ASTM A934 coatings believe that this provides a weakness to the corrosion system. Requirements within ASTM A775 and ASTM A934 are similar except for bendability and for the impact resistance of the coatings, where the requirements for ASTM A934 are less severe than those of the ASTM A775 coating due to increased brittleness of the ASTM A934 coating. The abrasion resistance of the ASTM A934 coating material is better than that of the ASTM A775 material. The patching materials for both products are required to pass similar tests to those for the bar coating material.

Products meeting ASTM A775 are still being utilized for the majority of specifications throughout North America; however, products meeting ASTM A934 are routinely provided to the California Department of Transportation (Caltrans) for use in marine waters and to the U.S. Navy. Caltrans uses products meeting ASTM A775 away from the coast. In the future, increasingly robust, yet flexible coatings will be developed by product suppliers.

Reference

1. Burke, D. F. 1994. "Epoxy-Coated Rebar in Marine Concrete." *Military Engineer*, 10-10. 

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