

**ARCANUM**  
ALLOYS

**Arcanum Alloys' Spatially Optimized Diffusion Alloy (SODA™) Optiform®  
Outperforms Traditional Material**

By Jack Kindred

Conventional commercial piping infrastructures used for non-potable water transportation, more specifically in fire suppression systems, are generally comprised of black pipe (i.e., mild-to-low carbon steel) or hot dipped zinc galvanized pipe.<sup>1</sup> While both materials perform well mechanically, there are inherent shortcomings associated with each. Black steel pipe is known to corrode with extended exposure to water and is susceptible to corrosion product build-up inside the pipe [1,2]. Galvanized steel pipe, though providing more protection against corrosion and corrosion product aggregation via a zinc coating, is prone to zinc flaking and thus obstructions inside the piping framework.[1,2]

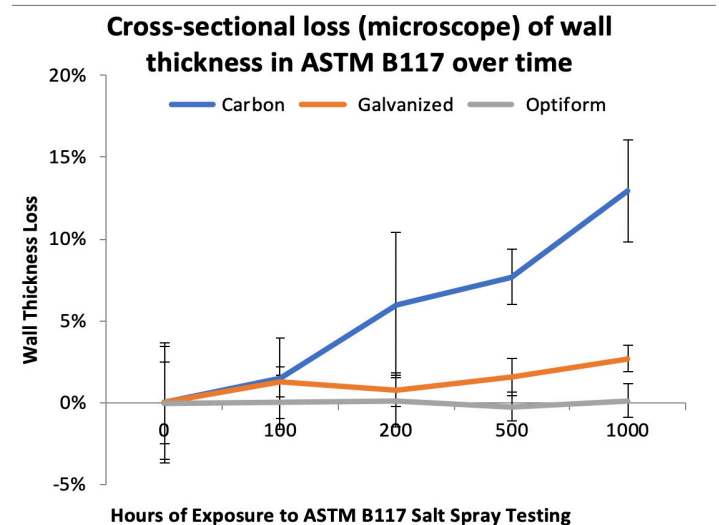
Within the fire sprinkler system design industry, pressure demand of the system must be realized and thus pressure losses of water flowing through the pipe requires calculation. The industry has uniformly turned to the Hazen-Williams formula (Equation 1) for pressure loss acquisition, which quantitatively estimates the interior of the pipe's smoothness rating (i.e., C-factor). Specifically, a higher C-factor correlates to a smoother pipe and intrinsically less frictional pressure losses. It has been well documented that the aforementioned material deficiencies of black carbon and galvanized steel negatively impact a system's ability to effectively deliver water in the instance of a fire [2,3,4]. Due to cost constraints, such structural arrays have remained relatively unchanged and have demonstrated few technological developments over the last several decades. [1,2,5]

### The Solution

Fortunately, Arcanum Alloys Inc., has made recent advancements in sheet steel manufacturing methodology allowing for better functionality. Arcanum Alloys' Optiform® product utilizes spatially optimized diffusion alloy (SODA™) technology within the manufacturing process to decouple surface materials from the bulk properties. This innovation has recently been leveraged by Bull Moose Tube Company to create state-of-the-art fire suppression system. Bull Moose Tube's product, HydroLogic™, has demonstrated superior corrosion resistance and high C-factor ratings compared to traditional materials, potentially resulting in a total cost of ownership reduction and increased service life in designed fire sprinkler systems [6]. Most recently, Bull Moose, was named a finalist for a AMM Fastmarket Annual Global Steel Award. HydroLogic (utilizing Arcanum Alloys' SODA and Optiform sheet steel) is in the running for Best Innovation: Product.



In a case study performed by Jack Kindred and colleagues, HydroLogic pipe was compared to black and galvanized steel pipe for corrosion performance and weld seam integrity. In the case of Arcanum's Optiform steel, because low carbon steel was utilized within the ERW and MIG welding processes to join the master pipe and weldolets together (i.e., dissimilar material), it was important to understand weld seam behavior within a corrosive environment. The scope of the work focused on subjecting pipes constructed of (1) Optiform, (2) black carbon steel, and (3) galvanized steel to corrosive conditions via ASTM B117 salt spray testing. The pipes were exposed to trials for specific periods of time, documented for general aesthetics and surface roughness, and then cut into cross sections at the weld seams for microscopic evaluation.



### Conclusion

From this study, qualitative and quantitative assessments of three different piping materials after ASTM B117 salt spray testing demonstrated that the surface optimized diffusion alloy of Optiform outperformed the conventional materials of construction utilized in

wet-pipe (black carbon steel) and dry-pipe (galvanized steel) fire sprinkler systems. MIG and ERW seam evaluations qualitatively demonstrated that the Optiform weld seams outperformed those of black steel pipe and were on par with the galvanized steel weldings. Aesthetically, Optiform exhibited far fewer sites of corrosion product formation on the pipe surface than either the black carbon or galvanized steel pipes. Additionally, measured surface roughness, wall thickness loss, and C-factor rating parameters all favored Optiform steel. For fire suppression system design, the aforementioned attributes of Optiform piping allow for two value propositions: (1) reduced hydraulic flow resistance and (2) fewer internal pipe restrictions. These traits can allow for the fire sprinkler system to be engineered with smaller diameter tubing, a less stringent water pump demand, reduced capital and maintenance costs, and an improved system lifespan [6].

To view the details of this study please visit:  
[www.arcanumalloys.com/whitepaper/optiform-outperforms/](http://www.arcanumalloys.com/whitepaper/optiform-outperforms/)

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#### About the Author

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