UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899-

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Dear Shane,

We have finished examining the welded stainless steel wire samples provided to us to date, and they have been returned to Gehry Partners.

In form of background, the samples we received were 14 welded wire pairs that had been exposed to various environments built around a 1000 hour modified salt fog test. Some of the samples had been decorated with carbon, and the atmosphere of the salt fog chamber was supplemented with sulfur dioxide gas. This was done to attempt to accurately reflect a somewhat more severe version of what the wires might be exposed to during a Washington DC year - the salt from the Bay and de-icer applied to nearby roads, the carbon to replicate soot primarily from diesel-powered buses, and the sulfur dioxide to replicate air pollution due to car exhaust. These 14 samples were presented to NIST as not reflective of the intended fabrication approach being considered by the design team. Samples fabricated using techniques under consideration are still being evaluated by the design team, and it is our understanding that they will be made available for testing by NIST at a later date.

Of the 14 samples provide to date, each sample was given an initial observation under an optical microscope. Both the region of the weld, where heat effects from welding may have modified the microstructure, and the unaffected wire far from the weld were examined for evidence of degradation. Away from the weld zone, no change to the wire from the salt fog test was observed in any of the samples. The wires remained smooth and the as-drawn surface topography was still visible.

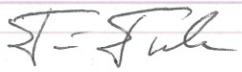
In the region near the weld, however, bands of "sparkles" were observed on nearly all samples. It was confirmed using a cotton swab that these features were not the result of either residual salt crystallized on the surface nor a residue of the carbon decoration applied before the salt fog test. A qualitative examination of each of the welded wire pairs revealed that all of the samples exhibited at least 3 of these "sparkle" features. The samples made of 304L steel had the most (again, qualitatively), while the 316L samples had slightly fewer. These conclusions are based on an average of all of the samples of each alloy, as there was minor variation between samples. The welds formed from 317L wire had considerably fewer "sparkles", estimated to be on the order of one-fifth that of a typical 316L sample. As pitting corrosion of the wire in the heat affected zone near the welds is a potential concern for long-term reliability, it was deemed important to determine whether these features were pits. To determine whether these contrast features were caused by depressions or bumps on the surface, an examination in a scanning electron microscope (SEM) of two samples (316L-A and 317L-A) was performed.

The weld samples were cut from the larger samples provided by the design team so that they would fit in the SEM chamber. The samples were imaged at 20kV and a working distance of 13 millimeters to obtain the best resolution on the highly inclined orientation of one of the wires. Resulting images have been transmitted to you under a separate cover with appropriate identifying annotations. In summary, SEM examination of the 316L-A welded sample revealed bands of corrosion pits approximately a millimeter from the weld bead. This is the location of the heat affected zone (HAZ) in the wire, where the heating during the welding process modified the microstructure of the wire near the weld. Pitting corrosion in the HAZ under salt fog conditions is

indicative of a process known as sensitization, whereby the chemistry of the wire has been modified making it more susceptible to corrosion. The pits observed were on the order of 1 to 40 micrometers in diameter (roughly circular) and 1 to 40 micrometers deep (roughly hemispherical). By way of comparison, when the 317L-A sample was viewed, the density of pits was much less, and the sizes were significantly smaller, scarcely more than 10 micrometers in diameter.

Based on our observations, the sensitization resulting from the welding procedures used to produce these 14 samples was the greatest in 304L, somewhat less in 316L and significantly less in the 317L stainless steel wire. While stainless steel is generally known to be a very resilient material known for its resistance to corrosion in many applications, at this time we are unable to make a determination regarding the durability of any of the base material stainless steel alloys (304L, 316L, and 317L) being considered for this particular application due to the inability to analyze the relevant samples still being analyzed by the design team. Notwithstanding the corrosion observed on the samples received thus far, there is no reason to believe that these results are necessarily indicative of the results that will be seen on the 4 samples fabricated with methods currently under consideration. We stand ready to examine those once they are made available.

Sincerely,



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