

**Performance Report for Rust Bullet**

**The Performance of Rust Bullet When Applied to Louver Arrays:  
A Series of Fish Swimming Experiments in Marine and Fresh Water**

**April 2008 to April 2011**

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## Introduction:

We constructed two steel louver-arrays that would be used to deter fish from passing into the downstream section of a laboratory flume. The experiment was designed to determine the frequency that fish would pass between the louvers blades when they were vibrating compared to when they were stationary. We wanted to coat the louver arrays with a product that would adhere to the unpainted steel, prevent rust from forming on the structure, and cause no toxic effects to the fish swimming in its presence. An image of an unpainted louver array is shown below.



## Procedures and Developments:

We received 4 quarts of Rust Bullet, at no charge, to paint the louvers and test the product's performance in ease of application, adhesion, rust prevention, and safety to fish during brief exposures. Two layers of the paint were applied to the louvers with hand brushes, outdoors at the University of California's Bodega Marine Laboratory, in Bodega Bay, CA. There was not quite enough of the product to cover all of the louver blades with two coats, but the majority of the louvers were covered twice. We had some difficulty applying the paint because the hand paint brushes we were using were too large to easily pass between the louver blades. Also the paint became very thick within the first hour of painting and started to spread across the louvers as a thick sticky coating.

We suspect the close proximity to the ocean, resulting in cool temperatures and fog-like conditions, started to rapidly cure the paint, making it difficult to apply. The louvers were left outside to cure for a week. Pictures of the painted louvers are shown below.



A close-up image of the louver array above shows that the paint was applied thick and uneven in areas, giving the louvers a slightly rough, patchy and lumpy texture.

The louvers were then used in laboratory fish swimming trials, where their base was submerged in sea water for three weeks. Below is a picture of the louver-array placed in the indoor fish-swimming flume.



During these trials, an industrial impactor (Martin PKL 150, <http://www.shake-it.com/pkl-interval-imp.shtml>) was used to produce rapid movements of the louver array. The impactor contacted the louver with individual blows, similar to being struck by hammer. We are pleased to report that none of the Rust Bullet coating appeared damaged or was removed by the impactor's operation. Below is a picture of the attached impactor.



The fish exposed to the Rust Bullet-coated louvers, during 15-min swimming experiments, showed no signs of acute exposure to a toxic substance. Chronic exposure effects were not evaluated. After three weeks of exposure to sea water, patches of rust appear on the louver-arrays. Some exposed rust spots and the uneven texture of the paint's coating can be seen in the picture below.



These small patches of rust likely resulted from small gaps being left in the coating when the thick paint was applied, which allowed water to contact the steel.

Following the marine experiments, the louver arrays were transported to the University of California Campus in Davis, CA, and used in multiple, freshwater fish-swimming experiments in 2009 and 2010. When the louvers first arrived, before any of the freshwater experiments were started, we purchased an additional supply of Rust Bullet and applied a third coat of the product onto the louvers. The Rust Bullet was much easier to spread in Davis, where the temperature was higher and relative humidity was significantly lower so the paint did not become thick. Also smaller-sized hand brushes were used, that fit easily between the louver-blades. Below is a picture of the repainted louver arrays, mounted in our freshwater flume.



During the freshwater fish swimming experiments, the base of the louver arrays were submerged in freshwater (well water), and the louvers were vibrated with an oscillating industrial vibrator at a low frequency (Martin NTK 25, <http://www.shake-it.com/ntk->

oscillators.shtml). A picture of the industrial vibrator attached to the louver array is shown below.



The Rust Bullet coating appeared to hold up well during the first set of freshwater fish swimming trials and only a few small patches of rust were observed. The vibrations induced throughout the louver arrays also did not appear to damage or detach any the paint. While swimming in the vicinity of the louver arrays, in 15-min freshwater swimming experiments, fish showed no signs of acute exposure to a toxic substance. No chronic exposure studies were conducted. A picture of a Chinook salmon (*Oncorhynchus tshawytscha*) resting near the base of a louver array is shown below.



The fish swimming experiments using the Rust Bullet-painted louver arrays continued intermittently throughout 2009 and 2010. The louver arrays have not received any additional coats of Rust Bullet since the application they received when they reached UC Davis in 2009. The final coating of the Rust Bullet has held up well with only a few spots of rust on its base where the coating has flaked off. The freshwater flume is located indoors and the louver arrays have been stored indoors to protect the Rust Bullet coating from exposure to the sun. Below is a current picture of the Rust Bullet coating on the louver arrays.



The white layer on the louver array has been made by “hard” water deposits forming on the louver array, just above the water's surface.

The images below show that only a few patches of rust are currently on the louver arrays, two years after the third coating of Rust Bullet was applied.



Currently, there are also a few places on the louver arrays where small sections of paint are peeling off as shown on middle louver blade in the picture below. Unfortunately, the image is slightly out of focus.



## Conclusions:

Overall we think the product served its intended purpose well. Once the louvers were fully covered with Rust Bullet, the paint adhered well to the steel louver blades, prevented the majority of the metal from rusting and did not appear to harm our fish. However, the application of the paint was fairly challenging, and the texture it left on the louvers was not smooth and even. We suspect that if we had used Rust Bullet Automotive, and spray painted the louver blades, the paint might have created an even, rust-proof coating on the louvers and would have been less likely to develop small rust spots or to flake off.

Thank you, again, for this generous opportunity to test your product.