Title:	Condition Assessment of Marine Structures Treated by Goldseal Anti Corrosive Coating
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Executive Summary

Quest Reliability Limited was requested by Rustproof Services NZ Limited of the Gold Seal Group to document and report on the condition of Chelsea Sugar Works Wharf and conveyor unloading facility on the Auckland Harbour, treated by Gold Seal Anti Corrosive coating.

The site was visited and the condition of the coatings examined in January 2009.Background information describing the coating history was provided and in combination with the visual inspection, it was possible to conclude that:

Chelsea wharf, a steel I-beam structure with a wooden deck is located on the Auckland City Harbour North Shore. The wharf was originally coated with a chlorinated rubber and completely over-coated with Gold Seal in 1993. The Gold Seal was spot repaired after reinforcing activities in 2003, when the deck was replaced. Metal parts without chlorinated rubber coating and coated in Gold Seal showed no degradation. The chlorinated rubber coating had variable thickness over which the Gold Seal was applied,and some parts of heavy chlorinated rubber coating were cracking under the Gold Seal.Cracking and lifting under the Gold Seal was also evident on bolts and rivets. The GoldSeal was in good condition, however the cracking and lifting of the chlorinated rubber
coating exposed the underlying surfaces to corrosion. New components and newly exposed old components that were not Gold Seal coated were suffering premature corrosion in the severe unwashed marine environment.

The Gold Seal coating over concrete or steal when applied in a severe marine environment worked best on previously uncoated components. Gold Seal provided a barrier to the severe marine environment with the coating showing slow degradation over time in sheltered areas and some level of weathering in exposed regions through direct exposure to the sun, wind and rain water under severe marine environments.

The Gold Seal coating on the Chelsea wharf has proved effective in controlling the corrosion on surfaces where it was applied. Those areas where the underlying coating of chlorinated rubber failed, were not protected and these areas are recommended to be sand blasted and coated only with the Gold Seal coating. The newly exposed galvanized fittings and deck beams are recommended to be water blasted and locally coated with the Gold Seal.

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1. Introduction

Quest Reliability Limited (QR) was asked by Rustproof Services NZ Limited of Gold Seal Group to conduct a condition assessment of the Chelsea marine structure, which were previously treated by Gold Seal Anti Corrosive coating (Gold Seal).

The structure was as follows:

- **Chelsea wharf,** on the Auckland Harbour, on the North Shore and affiliated with NewZealand Sugar Company Ltd.

The scope of the work was to:

- Review provided documentation.
- Conduct visual inspection of the structure.
- Document and report on the condition of the structure.

2. Background

2.1 Chelsea wharf

The wharf at the Chelsea Sugar Refinery Company Ltd. Was constructed in the year 1884. The wharf is supported by steel I-beams, which are exposed to the corrosive marine environment. It was understood that a black chlorinated rubber coating was used to coat parts of the wharf to prevent corrosion degradation of the structure.
Parts of the wharf structure were treated by the Gold Seal coating in 1993 to halt corrosion of exposed surfaces in locations where cracks in the coating occurred; although the primary rubber coating was not removed or replaced. The Gold Seal coating had been in service for approximately 16 years when inspected.

In the last six years, the wharf was refurbished and five additional galvanised support beams per bay, oriented parallel to the side beams, were attached to the old beams using galvanised clamps. These newly added beams were not treated with the Gold Seal coating. No detailed information regarding historical inspections of the coating integrity was provided prior to the 2009 visit.

3. Visual Inspection and Discussion

Summary on Performance of Gold Seal Coating

3.1 Chelsea wharf

Inspection of the wharf by QR took place in January 2009. All the observations were made from the bank and accessible areas underneath the wharf structure, Figure 1.
The Chelsea wharf reinforced concrete pillars had marine growths at the base indicating the

level of high tide. The I-beams in areas located near the shore exhibited thicker underlying coating (a primary chlorinated rubber coating) and Gold Seal over-coating. The rubber coating on many parts of the steel I-beams and rivets had begun to break down and flaking was much in evidence; however there was a distinct pattern of more damage on the afternoon sun side , than that partially shielded from the early morning sun. It appeared that the underlying coating had runs in it near the bank area and was excessively thick. On exposure to the sun after cold evenings the thick coating appeared to have failed by thermal expansion effects. The damage areas include some riveted parts, I-beams near the shore and extending to nearly the first concrete pillar. After this the underlying coating had not run, was not so thick and there was no flaking in evidence.

The chlorinated rubber coating was found degraded and cracked (Figure 2) in the areas of excessive thickness and subjected to thermal expansion. The Gold Seal coating was applied on the top of chlorinated rubber coating before the onset of cracking, and hence, there was no direct contact between the Gold Seal and the newly exposed parent material of the I beam. The Gold Seal coating, therefore, was not able to provide corrosion protection to the underlying steel substrate in these areas.

Areas that have been modified during wharf renovation and subsequently treated by the GoldSeal coating showed good performance, while renovations including new fittings that were not Gold Seal coated were experiencing onset of corrosion after six years. This corrosion was manifested in the form of white corrosion products on galvanised fittings, and in some instances by presence of red/brown corrosion products, which are typical of rust (Figure 3).

4. Conclusions and Recommendations

From the above it is possible to conclude and recommend the following:

The Gold Seal coating over concrete or steel when applied in a severe marine environment worked best on previously uncoated components. Where previous coatings are obviously failing prior to the application of Gold Seal, they should be waterblasted or manually removed (Rustproof Services NZ Limited reports that abrasive blasting is not a prerequisite in their coating data sheet). Gold Seal provided a barrier to the severe marine environment with the coating showing slow degradation over time in sheltered areas and some level of weathering in exposed regions through direct exposure to the sun, wind and rain water under severe marine environments.

The Gold Seal coating on the Chelsea wharf proved effective and controlling the corrosion on surfaces where it was applied. Those areas where the underlying coating of chlorinated rubber failed were not protected and these areas are recommended to be sand blasted and coated only with the Gold Seal coating. The newly exposed fittings are recommended to be water blasted and locally coated with the Gold Seal.

Chelsea Wharf – reinforced concrete pillars, steel substructure with wooden decking.

Chelsea Wharf – chlorinated rubber coated and Gold Seal over-coated steel substructure.

Chelsea Wharf – I-beam construction, Gold Seal coating not reinstated After 2006 modifications.

Figure 1.

Chelsea Wharf – coating under Gold Seal exhibiting cracking and flaking on rivets and I-beams.

Chelsea Wharf – coating under Gold Seal exhibiting cracking and flaking on I-beams.

Chelsea Wharf – flaking of chlorinated rubber under-layer.

Figure 2.

Chelsea Wharf – substructure, uncoated fittings and coating touch-up.

Chelsea Wharf – substructure, uncoated fittings and coated I-beams.

Chelsea Wharf – substructure, uncoated fittings and coated I-beams.

Figure 3.