

## *Dennis Richards*

TGO5 - Coatings and Corrosion Control

Materials

Pavements and Structures

### **Department for Transport, Energy and Infrastructure**

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Both RUST GRIP and ENAMO GRIP did lock and adhere to the substrate as required and showed no deterioration over a full seven year period in service.

The one thing that we have noticed from other applications in the field and test performed is that when the RUST GRIP is applied directly over the Lead-Based paint without having the Alkyd MIO present, the RUST GRIP would penetrate completely through the Lead-Based Paint and lock down the existing coating to the point of having a pull strength of MPa 6 or above. Having the Alkyd paint layer prevented to some degree the penetration that we normally have and allowed the Lead-Based paint to fail at lower pull strength because the RUST GRIP had not penetrated through it to help attach to the substrate beneath it.

We have bridges that are 12 years old and show no deterioration of the RUST GRIP and combination of RUST GRIP and top coat of ENAMO GRIP. Both systems are showing a possible 20 year system without failure.

I would have liked to have had the RUST GRIP applied directly over the Lead Based Paint to show how well it can penetrate through it and strengthen the entire system to the substrate, but I think everyone can see the strength and durability it brings to the bridge substrate or any surface it covers.

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## TRANSPORT SERVICES DIVISION

### Pavements & Structures Section – Materials Group

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Government  
of South Australia

Department for Transport,  
Energy and Infrastructure

## LABORATORY REPORT

Report To: Manager Technical Support  
Subject: Evaluation of coatings, Superior Hi-Tech  
Information Required: Adhesion and corrosion protection over existing painted steel on bridges

### 1.0 BACKGROUND

DTEI was first approached by Superior Hi-tech Coatings Australasia (SHC) in 2000 to evaluate a range of coatings and products for use on a range of infrastructure. Subsequent testing was carried out on a number of products on the Birkenhead Bridge on 19<sup>th</sup> December 2006. This report provides a summary of test data and observations from all tests.

### 2.0 PRODUCTS TESTED

The following materials were used or evaluated in this investigation:

Rust Grip Moisture cure single pack polyurethane, volume solids 51%  
Enamo Grip Two-pack aliphatic polyurethane, volume solids 46%  
Graffiti Cleaner Water reducible graffiti remover with active ingredients N-Methylpyrrolidinone (NMO) and Gamma-Butyrolactone (BLO)  
SPS Cleaner Solvent based surface cleaner  
Chlor Rid Surface soluble salt remover

### 3.0 PROCEDURE

Initial testing carried out in March 2000 involved the application of SHC coatings to the external girder (North Facing) of a bridge over a watercourse on the Magill – Lobethal Road, 2.59km east of RN 4496 (Gumeracha – Lobethal), Bridge Plan Number 747. Three separate patches were applied, as shown in Table 1.

Section (From Left)	Surface Preparation	Coating	No. of Coats
1	None	Rust Grip	2
2	None	Rust Grip	2
		Enamo Grip	2
3	Cleaned with SPS Cleaner	Rust Grip	2
		Enamo Grip	2

Table 1 – Coating Details, Bridge PN 747

A visual inspection was carried out, together with pull-off adhesion testing to AS1580.408.5, on Monday 18<sup>th</sup> December 2006. Adhesion testing was also carried out on the existing coatings on Tuesday 2<sup>nd</sup> January 2007, as a control.

Further testing was carried out on a number of products on the Birkenhead Bridge (Plan Number 1229) on 19<sup>th</sup> December 2006, with the coatings tested as detailed in Table 2.

Test Location	Test surface	Surface Preparation	Coating	No. of Coats
1 Western stiffener	Steel, red lead primer/ Alkyd MIO	Chlor Rid	Rust Grip	2
			Enamo Grip	2
2 Abutment web		Chlor Rid	Rust Grip	2
			Enamo Grip	2
3 Abutment web		Graffiti Cleaner	Rust Grip	2
			Enamo Grip	2
4 Underside of deck	Rebar/ concrete	None	Rust Grip	2
5 Cast Concrete guardrail end	Concrete	None	Enamo Grip Clear	2

Table 2 – Coating Details, Bridge PN 1229

Initial testing consisted of adhesion testing to AS1580.408.5, with test dollies adhered to test surfaces on Thursday 21<sup>st</sup> December 2006, 45 hours after completion of coating application. Pull-off tests were conducted on Friday 22<sup>nd</sup> December 2006. Adhesion testing was also carried out on the existing coatings on Tuesday 2<sup>nd</sup> January 2007, as a control.

#### 4.0 RESULTS AND DISCUSSION

Coatings on Bridge Plan Number 747 were inspected and found to exhibit no integrity failure. No cracking, checking, flaking, peeling, erosion, rusting or blistering was observed. The Enamo Grip finish also exhibited high gloss, comparable to the pre-exposure level. The adhesion test results are detailed in Appendix 1, and summarised in Table 3.

Existing Coatings	Surface Preparation	Coating System	Average Adhesion, Mpa
Iron oxide-zinc chromate primer, alkyd MIO	None	2 coats Rust Grip	0.5
	None	2 coats Rust Grip/ 2 coats Enamo Grip	1.25
	SPS Cleaner	2 coats Rust Grip/ 2 coats Enamo Grip	1.81
			2.0

Table 3 – Adhesion Results, Bridge PN 747

The pull-off adhesion test identifies the weakest point within any coating system, which in the case of all tests was identified as a cohesive failure within the existing coatings. No failure occurred at the junction between the old and new coatings, or within the new coating layers. Given that the adhesion figures for red oxide zinc chromate primer are typically low, in the range of 0.5 to 2.0 MPa, the test results can be

considered as normal for this coating system. There was no evidence of any negative effect of the over-coating system on the adhesion of the existing coatings.

The adhesion test results for the coatings applied to the Birkenhead Bridge are detailed in Appendix 2, and summarised in Table 4.

Test Substrate	Surface Preparation	Coating System	Average Adhesion, Mpa
Steel, red lead primer, alkyd MIO	Chlor Rid	2 coats Rust Grip/ 2 coats Enamo Grip	1.9
	Graffiti Cleaner	2 coats Rust Grip/ 2 coats Enamo Grip	2.1
Concrete	None	2 coats Rust Grip	3.5
	None	2 coats Enamo Grip Clear	2.25
Steel, red lead primer, alkyd MIO			2.0

Table 4 – Adhesion Results, Bridge PN 1229

The pull-off adhesion test identifies the weakest point within any coating system, which, in the case of the tests conducted over existing coatings, was identified as a cohesive failure within the red lead primer. No failure occurred at the junction between the old and new coatings, or within the new coating layers. Given that the adhesion figures for red lead primer are typically low, in the range of 0.5 to 2.0 MPa, the test results can be considered as normal for this coating system. There was no evidence of any negative effect of the over-coating system on the adhesion of the existing coatings.

Both the Rust Grip and Enamo Grip provided good adhesion levels over the concrete substrate.

## 5.0 CONCLUSIONS

The conclusions drawn from this investigation were as follows:

- Both the Rust Grip and Rust Grip/ Enamo Grip coating systems provided almost 7 years exposure performance, with no integrity failure, over a structure exposed in a Category C environment.
- Pull-off adhesion testing indicated that the Rust Grip and Rust Grip/ Enamo Grip coating systems provided adequate adhesion over existing weathered coating systems, both initially and after almost 7 years of exposure.
- Pull-off adhesion testing indicated that the Rust Grip and Rust Grip/ Enamo Grip coating systems had no negative effect on the adhesion of existing coating systems.
- Both the Rust Grip and Enamo Grip provided good adhesion levels over the concrete substrate.

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Date: 10 / 01 /2007

ccG. Mackey  
Manager Technical Support

D. Richards  
TGO05 Coatings and Corrosion Control  
INVESTIGATING OFFICER  
SUPERVISING OFFICER

## Appendix 1

Dept. for Transport, Energy and Infrastructure  
Pavements and Structures, 19 Bridge Road, Walkley Heights SA 5098  
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### Adhesion – Pull-off Test

#### AS 1580.408.5

Instrument Type      Elcometer 106  
Instrument ID        217-001

Test Location        Bridge PN 747  
Test Date            18<sup>TH</sup> December 2006

Adhesive Used        Araldite K136  
Curing details        72 hours, warm to hot conditions

#### Legend

Substrate	A
Existing primer (Iron Oxide Zinc Chromate)	B
Existing intermediate and finish Coat (Alkyd MIO)	C
Glue	D
Superior Hi-Tech Rust Grip	E

#### Test Locations

Test Dolly No.	Test Section (See Clause 2)
1 & 2	1

#### Results

Test Dolly No.	MPa	Failure Interface	Area at failure, %	Observations
1	0.5	B/C	95% B	Cohesive failure within existing coatings
2	0.5	B/C	95% B	Cohesive failure within existing coatings

Tested By      D. Richards

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Adhesive Used        Araldite K136  
Curing details        72 hours, warm to hot conditions

Legend

Substrate	A
Existing primer (Iron Oxide Zinc Chromate)	B
Existing intermediate and finish Coat (Alkyd MIO)	C
Glue	D
Superior Hi-Tech Rust Grip	E
Superior Hi-Tech Enamo Grip	F

Test Locations

Test Dolly No.	Test Section (See Clause 2)
3 & 4	2
5, 6, 7 & 8	3

Results

Test Dolly No.	MPa	Failure Interface	Area at failure, %	Observations
3	1.0	B/C	60% B	Cohesive failure within existing coatings
4	1.5	B/C	75% B	Cohesive failure within existing coatings
5	2.5	B/C	40% B	Cohesive failure within existing coatings
6	1.25	B/C	85% B	Cohesive failure within existing coatings
7	2.0	B/C	10% B	Cohesive failure within existing coatings
8	1.5	B/C	50% B	Cohesive failure within existing coatings

Tested By      D. Richards

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**Adhesion – Pull-off Test**

**AS 1580.408.5**

Instrument Type      Elcometer 106  
Instrument ID        217-001

Test Location        Bridge PN 747  
Test Date            2<sup>nd</sup> January 2007

Adhesive Used        Araldite K136  
Curing details        116 hours, warm to hot conditions

Legend

Substrate	A
Existing primer (Iron Oxide Zinc Chromate)	B
Existing intermediate and finish Coat (Alkyd MIO)	C
Glue	D

Test Locations

Test Dolly No.	Test Section
9 & 10	Existing coatings on outer web

Results

Test Dolly No.	MPa	Failure Interface	Area at failure, %	Observations
9	2.0	B/C	70% B	Cohesive failure within existing coatings
10	2.0	B/C	70% B	Cohesive failure within existing coatings

Tested By      D. Richards

**Appendix 2**

Dept. for Transport, Energy and Infrastructure  
Pavements and Structures, 19 Bridge Road, Walkley Heights SA 5098

PO Box 82 Enfield Plaza SA 5085, Telephone: 8260 0230

**Adhesion – Pull-off Test, AS 1580.408.5**

Instrument Type      Elcometer 106  
Instrument ID        217-001

Test Location        Bridge PN 1229  
Test Date            22<sup>nd</sup> December 2006

Adhesive Used        Araldite K138  
Curing details        24 hours, warm to hot conditions

Legend

Substrate	A
Existing primer (Red Lead)	B
Existing intermediate and finish Coat (Alkyd MIO)	C
Superior Hi-Tech Rust Grip	D
Superior Hi-Tech Enamo Grip	E
Glue	F

Test Locations

Test Dolly No.	Test Section (See Clause 2)
1 & 2	1
3, 4 & 5	2
6, 7 & 8	3

Results

Test Dolly No.	MPa	Failure Interface	Area at failure, %	Observations
1	2.0	B/C/D/E/F	45% B/C	Failure at red lead/ Alkyd MIO interface
2	0.5	B	90% B	Cohesive failure within existing coatings
3	3.5	B/C	60% B	Cohesive failure within existing coatings
4	1.5	B/C	55% B	Cohesive failure within existing coatings
5	2.0	B/C	55% B	Cohesive failure within existing coatings
6	3.25	B/C	65% C	Cohesive failure within existing coatings
7	1.75	B/C	85% B	Cohesive failure within existing coatings
8	1.25	B/C	80% B	Cohesive failure within existing coatings

Tested By      D. Richards

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**Adhesion – Pull-off Test**

**AS 1580.408.5**

Instrument Type      Elcometer 106  
Instrument ID        217-001

Test Location        Bridge PN 1229  
Test Date            22<sup>nd</sup> December 2006

Adhesive Used        Araldite K138  
Curing details        24 hours, warm to hot conditions

Legend

Substrate (Concrete)	A
Superior Hi-Tech Rust Grip	B
Glue	C

Test Locations

Test Dolly No.	Test Section (See Clause 2)
9 & 10	4

Results

Test Dolly No.	MPa	Failure Interface	Area at failure, %	Observations
9	4.0	B/C	75% B	Cohesive failure within Rust Grip
10	3.0	A/B/C	60% C 20% B	Glue failure at dolly interface and Rust Grip interface

Tested By      D. Richards

## Adhesion – Pull-off Test

### AS 1580.408.5

Instrument Type      Elcometer 106  
Instrument ID        217-001

Test Location        Bridge PN 1229  
Test Date            22<sup>nd</sup> December 2006

Adhesive Used        Araldite K138  
Curing details        24 hours, warm to hot conditions

#### Legend

Substrate (Concrete)	A
Superior Hi-Tech Enamo Grip Clear	B
Glue	C

#### Test Locations

Test Dolly No.	Test Section (See Clause 2)
11	5

#### Results

Test Dolly No.	MPa	Failure Interface	Area at failure, %	Observations
11	2.25	A/B/C	60% B/C 40% A	Glue failure at dolly interface and Enamo Grip interface Concrete cohesive failure

Tested By      D. Richards

**Adhesion – Pull-off Test, AS 1580.408.5**

Instrument Type      Elcometer 106  
Instrument ID        217-001

Test Location         Bridge PN 1229  
Test Date             4<sup>th</sup> January 2007

Adhesive Used         Araldite K138  
Curing details        48 hours, warm to hot conditions

Legend

Substrate	A
Existing primer (Red Lead)	B
Existing intermediate and finish Coat (Alkyd MIO)	C
Glue	D

Test Locations

Test Dolly No.	Test Section
12 & 13	Existing coated steel

Results

Test Dolly No.	MPa	Failure Interface	Area at failure, %	Observations
12	2.0	B	90% B	Cohesive failure within red lead
13	2.0	B	90% B	Cohesive failure within red lead

Tested By      D. Richards