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BRITISH BOARD OF AGRÉMENT TEST REPORT No 5891

SEALSYSTEMS ELASTOCOAT POLY UREA BRIDGE DECK WATERPROOFING MEMBRANE

Contents

Approved by:

Mark East
(Senior Testing Technician)

Date: 21 June 2010

Authorised by:

Mike Beale
(Testing Unit Leader)

Date: 21 June 2010

On behalf of the British Board of Agrément

Client: Sealsystems (Ireland) Limited

Address: Unit 243 Blanchardstown Corporate Park
Blanchardstown
Dublin 15
Ireland

Job No: T1/44511

Work period: June 1999 to April 2010

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1 REPORT CONDITIONS

1.1 This Report:

- relates only to the product/system and sample/specimen thereof named and described herein
- relates only to the test conditions described herein
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2 SAMPLE PREPARTION

Sample preparation took place at the Elastogran factory, Boxtel, the Netherlands on 24 to 26 June 2009.

Approximate temperature range was 21.7 to 22.6°C and the humidity was 43.7% to 49.3% RH.

The materials used were as follows:

Primer Part A batch 0098, Part B batch 636733
Sand M, 1200-F5
Elastocoat C 6335/101/7042 Art 57572298 Lot NL20571069
Isocyanate component Art 51368329 Lot DE27548444
Tack coat Mastertop P 690 (Conipure90) Art 50151450 Lot 0002581260. This was found to be unsuitable and was replaced with Quictac (applied at a later date, see below)

24 June
All blocks were air blasted and then primed (see above for batch details) using a small foam paint roller at a spreading rate of 175gsm (300gsm is usual but the dense concrete would not absorb the primer). The sand was then sprinkled onto the primed concrete at a rate of 1000 gsm and the excess brushed off.

25 June
The Elastocoat was heated to approximately 70-75°C in the spray equipment.
The free film was sprayed onto waxed stainless steel sheets at a 2 mm nominal thickness (recommended 2 mm for protected decks and 3mm for unprotected decks).

The dry blocks (and the crack cycling test samples and various other test blocks) were then coated. Pin holing was immediately noted, the pin holes appeared to line up with air pocket holes in the concrete that were not filled by the primer. Coating of the blocks was halted while some experimentation took place on spare blocks. It was found that a second coating of primer sealed the air pocket holes in the first primer coat. It was agreed between the client and the BBA that a second coat of primer would be used on the remainder of the test blocks with no sand added.

26 June

Application of the membrane to the damp pinhole test blocks, the crack cycling blocks and the remainder of the 170 mm by 170 mm test blocks were undertaken un-witnessed by the BBA.

It was agreed with the BBA that the site application method will include two primer coats with the sand applied to the second coat.

3 THICKNESS

3.1 Method

In accordance with the *HAPAS Guidelines Document for the Assessment and Certification of Waterproofing Systems for Use on Concrete Decks of Highway Bridges :* March 2005:
Section 3.2.2.7: *Thickness*.
Measurements were carried out using a dial gauge fitted with an 8 mm diameter platen and loaded with 92 g (applying a load of 22 ±5 kPa).

The membrane was cut into six strips with ten readings taken per strip.

3.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/1	10	Sealsystems membrane free film

3.3 Results

Thickness (mm)						
Strip No	1	2	3	4	5	6
Reading No						
1	2.05	2.36	2.38	2.18	1.95	2.12
2	2.11	2.33	2.49	2.13	0.91	2.05
3	2.19	2.39	2.36	2.20	1.98	2.07
4	2.05	2.19	2.24	2.34	2.09	2.03
5	1.92	2.06	2.15	2.37	2.11	2.08
6	1.86	2.15	1.90	2.43	2.12	2.09
7	1.86	2.00	1.90	2.58	2.39	2.19
8	1.72	2.11	1.83	2.66	2.43	2.31
9	1.91	1.92	1.72	2.75	2.45	2.32
10	1.81	1.85	1.87	2.70	2.36	2.37
					Mean	2.14
					Minimum	0.91
					Maximum	2.75

4 WEIGHT PER UNIT AREA

4.1 Method

In accordance with the *HAPAS Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highways Bridges:* March 2005.
Section 3.2.2.8: *Weight per unit area.*

4.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/1	10	Sealsystems membrane free film

4.3 Results

No	Weight (g)	Weight per unit area (kg m^{-2})
1	48.94	2175
2	42.97	1910
3	52.38	2328
Mean	-	2138

5 WATER ABSORPTION

5.1 Method

In accordance with the *HAPAS Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highways Bridges:* March 2005.
Section 3.2.2.9: *Water absorption.*

5.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/1	10	Sealsystems membrane free film

5.3 Results

Specimen No	Water absorption after immersion (%)
1	2.3
2	2.0
3	2.1
Mean	2.1

6 RESISTANCE TO WATER PENETRATION

6.1 Method

In accordance with the *HAPAS Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highways Bridges:* March 2005. Section 3.2.2.10: *Resistance to water penetration*.

6.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/1	10	Sealsystems membrane free film
T1/44511/9	2	Sealsystems membrane incorporating a joint

6.3 Results

Batch No	Observations
1	No leakage after 28 days with 6 m head
9	No leakage after 28 days with 6 m head

7 RESISTANCE TO PIN/BLOW HOLING

7.1 Method

In accordance with the *HAPAS Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highways Bridges:* March 2005.
Section 3.2.2.12: *Resistance to pin/blow holing for liquid applied membranes.*

300 x 300mm blocks were removed from water, after 24 hours immersion, allowed to dry for three hours then air blasted. The moisture content (of the wet and dry blocks) was checked using the clients moisture meter (see results table). All blocks were primed using a small foam paint roller. The rate of application was only 175 gsm due to the dense nature of the concrete (target application rate was 300 gsm). Sand was then sprinkled into the wet primer at a spreading rate of 1000 gsm and the excess brushed off.

The dry blocks (and various other blocks) were then coated. Pin holing was immediately noted. The pin holes appeared to line up with air pocket holes in the block that were not filled by priming. Coating of the damp blocks was halted while some experimentation took place on spare blocks. It was found that a second coating of primer sealed the air pocket holes in the first primer coat. It was agreed between the client and the BBA that a second coat of primer would be used on the remainder of the test blocks with no sand added.

Application of the membrane to the damp pinhole test blocks and the remainder of the 170mm by 170mm test blocks was undertaken the following day (not witnessed by the BBA).

Laboratory examination of the blocks for pin holes etc took place after the blocks had been returned to the BBA and booked in as test samples.

It was agreed with the BBA that the site application method will include two primer coats with the sand applied to the second coat.

7.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/2	6	Sealsystems membrane applied to dry concrete.
T1/44511/3	6	Sealsystems membrane applied to wet concrete.

7.3 Results

Description	Approximate moisture content (%)	Block No	Quantity of holes	Range of hole Diameters (mm)
Batch 2 (Dry concrete) with one coat of primer sanded	0.5-0.75	1 2 3	4 9 13	1-2.5 1-3 1-3
Batch 3 (Damp concrete) with two coats of primer first coat was sanded second coat was un-sanded	5-6	1 2 3	0 0 0	N/A N/A N/A

8 TENSILE ADHESION

8.1 Method

In accordance with HAPAS *Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges :* March 2005.
Section 3.3.2.1: *Tensile adhesion at -10, 23 and 40^{0}C*.

8.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/5	33	Sealsystems membrane on 170 x 170 mm concrete

8.3 Results

Temperature (°C)	No	Stress at failure (Nmm^{-2})	Mode of failure (/= interface)
-10	1	1.91	90% within concrete, 10% concrete/primer
	2	1.30	95% within concrete, 5% concrete/primer
	3	1.53	95% within concrete, 5% concrete/primer
23	1	1.64	95% within concrete, 5% concrete/primer
	2	1.16	50% within concrete, 50% concrete/primer
	3	1.76	90% within concrete 10% concrete/primer
40	1	1.80	90% within concrete, 10% primer/membrane
	2	1.65	90% within concrete, 10% primer/membrane
	3	1.25	90% within concrete, 10% primer/membrane

9 RESISTANCE TO CHLORIDE ION PENETRATION

9.1 Method

In accordance with HAPAS *Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges:* March 2005. Section 3.3.2.2: *Resistance to chloride ion penetration.*

Specimens for chloride ion penetration were sent to Vinci Construction (UK) for grinding and chloride ion determination. See Certificate of Test No: 12926 as Appendix 1.

9.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/5	33	Sealsystems membrane on 170 x 170 mm concrete

9.3 Results

No	Volume loss (ml)	Chloride ion (%)
1	1.6	0.02
2	1.6	0.01
3	1.2	0.02

10 RESISTANCE TO FREEZE-THAW

10.1 Method

In accordance with HAPAS *Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges:* March 2005.
Section 3.3.2.3: *Resistance to freeze-thaw.*

Specimens for chloride ion penetration were sent to Vinci Engineering (UK) for grinding and chloride ion determination. See Certificate of Test No: 12926, as Appendix 1.

10.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/5	33	Sealsystems membrane on 170 x 170mm concrete

10.3 Conditioning

Freeze-thaw - six freeze-thaw cycles consisting 8 hours freezing at -10°C followed by 16 hours thawing by surface water at >5°C.

10.4 Results

Each specimen was subjected to six freeze-thaw cycles. No visible damage occurred.

Tensile adhesion

No	Stress at failure (Nmm^{-2})	Mode of failure (/= interface)
1	1.69	10% within concrete, 90% membrane/primer
2	1.32	20% within concrete, 80% membrane/primer
3	1.87	90% within concrete, 10% membrane/primer

Chloride ion penetration

No	Volume loss (ml)	Chloride ion (%)
1	1.6	0.01
2	1.6	0.02
3	2.0	0.01

11 RESISTANCE TO HEAT AGEING

11.1 Method

In accordance with HAPAS *Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges*: March 2005.
Section 3.3.2.4: *Resistance to heat ageing at 70^0C for 28 days.*

Specimens for chloride ion penetration were sent to Vinci Engineering (UK) for grinding and chloride ion determination. See Certificate of Test No: 12926, as Appendix 1.

11.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/5	33	Sealsystems membrane on 170 x 170 mm concrete

11.3 Conditioning

Heat ageing - Stored in a ventilated oven controlled at 70°C for 28 days

11.4 Results

Tensile adhesion

No	Stress at failure (Nmm^{-2})	Mode of failure
1	1.63	20% within concrete, 80% membrane/primer
2	1.22	80% within concrete, 20% membrane/primer
3	1.85	100% within concrete

Chloride ion penetration

No	Volume loss (ml)	Chloride ion (%)
1	5	0.02
2	49*	0.02
3	4	0.01

*Glassware seal faulty

12 RESISTANCE TO CHISEL IMPACT

12.1 Method

In accordance with HAPAS *Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges*: March 2005.
Section 3.3.2.5: *Resistance to chisel impact.*

Specimens for chloride ion penetration were sent to Vinci Engineering (UK) for grinding and chloride ion determination. See Certificate of Test No: 12926, as Appendix 1.

12.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/5	33	Sealsystems membrane on 170 x 170 mm concrete

12.3 Results

Test temperature (°C)	No	Effect of chisel impact	Volume loss (ml)	Chloride ion (%)
-10	1	Slight marking	0.4	0.01
	2	Slight marking	0.4	0.01
	3	Slight marking	2.0	0.01
23	1	Slight marking	1.6	0.02
	2	Slight marking	0.4	0.01
	3	Slight marking	1.6	0.01
40	1	Slight marking	1.6	0.01
	2	Slight marking	0.8	0.02
	3	Slight marking	1.6	0.02

13 RESISTANCE TO AGGREGATE INDENTATION

13.1 Method

In accordance with *HAPAS Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges*: March 2005.
Sections 3.3.2.6: *Resistance to aggregate indentation at 40^0C,* 3.3.2.7: *Resistance to aggregate indentation at 80^0C* and 3.3.3.1: *Resistance to aggregate indentation at 125°C.*

Specimens for chloride ion penetration were sent to Vinci Engineering (UK) for grinding and chloride ion determination. See Certificate of Test No12926, as Appendix 1.

13.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/6	9	Sealsystems membrane on 170 x 170 mm concrete (Agg ind)

13.3 Results

Indentor temperature / Environment temperature (°C)	No	Original thickness (mm)	Recovered indentation depth		Volume loss (ml)	Chloride ion (%)
			(mm)	(%)		
40/40	1	2.36	2.27	96.45	2.8	0.01
	2	2.20	2.17	98.60	1.2	0.02
	3	2.17	2.13	98.14	0.8	0.02
80/40	1	1.83	1.81	99.18	1.2	0.01
	2	2.07	2.05	98.90	1.2	0.01
	3	2.09	2.02	96.66	0.4	0.02
125/50	1	2.56	2.20	85.70	2.0	0.02
	2	2.18	1.81	83.02	1.6	0.01
	3	2.36	2.03	85.92	1.2	0.01

14 THERMAL SHOCK, HEAT AGEING AND CRACK CYCLING

14.1 Method

In accordance with HAPAS *Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges*: March 2005.
Section 3.3.2.8: *Thermal shock, heat ageing and crack cycling at -10, 23 and 40°C.*

Specimens for chloride ion penetration were sent to Vinci Engineering (UK) for grinding and chloride ion determination. See Certificate of Test No: 12926, as Appendix 1

.

14.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/4	9	Sealsystems membrane on 400 x 220 mm concrete

14.3 Conditioning

All specimens were subjected to the following: Thermal shock achieving 145°C at the membrane surface followed by 28 days at 70°C in a ventilated oven.

14.4 Results

Test temperature (°C)	No	Observations	Volume loss (ml)	Chloride ion (%)
-10	1	No visual cracking	1.6	0.01
	2	No visual cracking	2.0	0.01
	3	No visual cracking	3.2	0.01
23	1	No visual cracking	2.8	0.01
	2	No visual cracking	2.4	0.01
	3	No visual cracking	2.4	0.02
40	1	No visual cracking	2.8	<0.01
	2	No visual cracking	3.6	0.01
	3	No visual cracking	2.8	0.01

15 HOT ROLLED ASPHALT SURFACING TO WATERPROOFING SYSTEM INTERFACE SHEAR ADHESION

15.1 Method

In accordance with HAPAS *Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges*: March 2005.
Section 3.3.3.2: *Hot rolled asphalt surfacing to waterproof system interface shear adhesion test at -10, 23 and 40°C.*

The asphalt surfacing was applied to the test specimens by Nottingham Centre for Pavement Engineering.

15.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/16	9	Quicktac tack coat and HRA applied to 150mm slab (ex batch 13)

15.3 Results

Test temperature (°C)	No	Failing stress (N mm^{-2})	Mode of failure (/= interface)
-10	1	1.8	100% membrane/tack coat
	2	1.2	100% membrane/tack coat
	3	1.7	100% membrane/tack coat
23	1	0.3	100% within tack coat
	2	0.4	100% within tack coat
	3	0.4	100% within tack coat
40	1	0.1	100% tack coat/asphalt
	2	0.1	100% tack coat/asphalt
	3	0.1	100% tack coat/asphalt

16 HOT ROLLED ASPHALT SURFACING TO WATERPROOFING SYSTEM INTERFACE TENSILE BOND

16.1 Method

In accordance with HAPAS *Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges*: March 2005.
Section 3.3.3.3: *Hot rolled asphalt to waterproofing surface interface tensile bond strength.*

The asphalt surfacing was applied to the test specimens by Nottingham Centre for Pavement Engineering.

16.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/18	3	Quicktac tack coat and HRA applied to 300mm slab (ex batch 12)

16.3 Results

Test	Failing stress (N mm^{-2})	Mode of failure (/= interface)
1	0.8	90% membrane/tack coat, 10% within tack coat
2	0.9	90% membrane/tack coat, 10% within tack coat
3	0.8	90% membrane/tack coat, 10% within tack coat
4	0.7	90% membrane/tack coat, 10% within tack coat
5	0.9	90% membrane/tack coat, 10% within tack coat
6	1.0	90% membrane/tack coat, 10% within tack coat

17 SAND ASPHALT SURFACING TO WATERPROOFING SYSTEM INTERFACE SHEAR ADHESION

17.1 Method

In accordance with HAPAS *Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges*: March 2005, Section 3.3.2.9: *Sand asphalt surfacing to waterproof system interface shear adhesion test at -10, 23 and 40°C*

The asphalt surfacing was applied to the test specimens by Nottingham Centre for Pavement Engineering.

17.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/15	9	Quicktac tack coat and SAC applied to 150mm slab (ex batch 13)

17.3 Results

Test temperature (°C)	No	Failing stress (N mm^{-2})	Mode of failure (/= interface)
-10	1	1.5	100% membrane/tack coat
	2	1.5	100% membrane/tack coat
	3	1.3	100% membrane/tack coat
23	1	0.3	100% tack coat/sand asphalt
	2	0.3	100% tack coat/sand asphalt
	3	0.3	100% tack coat/sand asphalt
40	1	0.1	100% tack coat/sand asphalt
	2	0.1	100% tack coat/sand asphalt
	3	0.1	100% tack coat/sand asphalt

18 SAND ASPHALT SURFACING TO WATERPROOFING SYSTEM INTERFACE TENSILE BOND

18.1 Method

In accordance with HAPAS *Guidelines Document for the Assessment and Certification of Waterproofing Systems for use on Concrete Decks of Highway Bridges*: March 2005.
Section 3.3.2.10: *Sand asphalt to waterproofing surface interface tensile bond strength.*

The asphalt surfacing was applied to the test specimens by Nottingham Centre for Pavement Engineering.

18.2 Samples

BBA ref/batch	Quantity	Description
T1/44511/17	3	Quicktac tack coat and SAC applied to 300mm slab (ex batch 12)

18.3 Results

Test	Failing stress (N mm^{-2})	Mode of failure (/= interface)
1	0.7	100% membrane/tack coat
2	0.7	100% membrane/tack coat
3	>1.0	Substrate failure, bond intact
4	1.0	100% membrane/tack coat
5	>1.0	Substrate failure, bond intact
6	-	Unable to test

Appendix 1: Vinci Test Certificate 12926

Certificate of Test

Title: Determination of Chloride Ion Content of concrete Dust from 36 Coated Concrete Slabs (Your ref (T1/144511)

Certificate of Test Number: 12926

Client's Name & Address:

Mr Mark East
British Board of Agrément
PO Box 195
Bucknalls Lane
Garston
Watford, WD25 9BA

Our Ref: N950/V018

TC Job No: 3NF3 – 1.003.46

Your Ref: PO 0000701160

Date: 17 February 2010

Date sample(s) received: 19 January 2010

Sample(s) received from: BBA

Sample No: 145567 - 145602

Tested by: .....
D J Thompson (position: Engineer)

Authorised by: .....
S R Moxon (position: Manager)

This Certificate and the results shown are based upon the information drawings samples and tests referred to herein

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UKAS TESTING
0057

TECHNOLOGY CENTRE

1. INTRODUCTION

This certificate of test describes the chloride ion content determination of concrete dust drillings from coated concrete carried out at the request of the British Board of Agrément on 10-11 February 2010 at Technology Centre (TC), Leighton Buzzard.

The test was carried out in accordance with our UKAS accredited In-House Test Procedure TP/1303/90/4670 Issue 9, which is based upon BS 1881 Pt124.

2. SAMPLE DESCRIPTION

Thirty-six coated concrete samples were received by the Materials Testing Laboratories. When received, each specimen was designated with a unique reference number, which was used for our own identification purposes. No certificate of sampling was received.

3. TEST PROCEDURE

3.1 Test Preparation

Each coated slab was sliced approximately into two specimens and then had the coating mechanically removed before drying at 105±5°C for a minimum of 16 hours. From the now exposed face of each specimen, a single 0-3mm depth increment dust was profile ground using a diamond coring bit. The resulting dust was passed through a 150µm sieve and the <150µm dust kept for analysis. This allowed for duplicate dust specimens to be created from each coated concrete sample received.

3.2 Determination of Chloride Ion Content

Each specimen was analysed in general accordance with In House Test Procedure TP/1303/90/4670 Issue 9.

Between 0.5 - 3.0g of the sample was accurately weighed into a clean oven dried glass container. Nitric acid 10% (approximately 50-70cm^3) was cautiously added to the sample, which was then left to stand with occasional stirring. The sample was then examined to ensure complete dissolution. Automatic potentiometric titration, with continuous stirring was used to analyse the sample. The titrator was a Metrohm 798 MPT Titrino and the course of the titration was monitored using a Metrohm electrode system.

Control samples of known chloride content (0.12 ± 0.01% by weight of sample) were analysed in parallel with the test samples.

The results of these control samples are used as a check on the accuracy of the method and are included in the Table of Results.

4. TEST RESULTS

The results of the analyses are detailed the following 2 Tables of this certificate.

Chloride Analysis Test Results

Table 1

Sample Identification	TC Sample Number	Depth Range (mm)	Weight of Sample Used For Analysis (g)	Chloride Content by Dry Wt. of Sample (%)
Control Dust	**129673A**	**-**	**2.8256**	**0.12**
T1/44511 - 5891/1	145567A	0-3	2.3153	0.02
	145567B	0-3	2.0910	0.01
T1/44511 - 5891/2	145568A	0-3	2.1394	0.01
	145568B	0-3	2.2102	0.01
T1/44511 - 5891/3	145569A	0-3	1.8786	0.02
	145569B	0-3	1.9579	0.02
T1/44511 - 5891/4	145570A	0-3	1.7811	0.01
	145570B	0-3	2.0860	0.01
T1/44511 - 5891/5	145571A	0-3	1.5140	0.01
	145571B	0-3	1.7201	0.02
T1/44511 - 5891/6	145572A	0-3	1.6238	0.01
	145572B	0-3	1.6852	0.01
T1/44511 - 5891/7	145573A	0-3	1.5618	0.02
	145573B	0-3	1.7532	0.01
T1/44511 - 5891/8	145574A	0-3	1.9737	0.02
	145574B	0-3	0.1965	0.02
T1/44511 - 5891/9	145575A	0-3	1.6534	0.01
	145575B	0-3	0.7108	0.01
T1/44511 - 5891/10	145576A	0-3	1.7018	0.01
	145576B	0-3	1.5853	0.01
T1/44511 - 5891/11	145577A	0-3	2.0797	0.01
	145577B	0-3	1.8452	0.01
T1/44511 - 5891/12	145578A	0-3	1.7083	0.01
	145578B	0-3	1.8213	0.01
Control Dust	**127633B**	**-**	**2.0408**	**0.12**
T1/44511 - 5891/13	145579A	0-3	1.9986	0.01
	145579B	0-3	2.1672	0.02
T1/44511 - 5891/14	145580A	0-3	2.0784	0.01
	145580B	0-3	1.8318	0.01
T1/44511 - 5891/15	145581A	0-3	2.0651	0.01
	145581B	0-3	1.8151	0.01
T1/44511 - 5891/16	145582A	0-3	1.8858	0.01
	145582B	0-3	1.6904	0.01
T1/44511 - 5891/17	145583A	0-3	1.5013	0.02
	145583B	0-3	1.5783	0.02
T1/44511 - 5891/18	145584A	0-3	1.5658	0.02
	145584B	0-3	1.6232	0.02
Control Dust	**127633C**	**-**	**2.0475**	**0.12**

Date samples tested: 10 Feb 2010

TC-N950-TEMP-066(A)

Chloride Analysis Test Results (Continued)

Table 2

Sample Identification	TC Sample Number	Depth Range (mm)	Weight of Sample Used For Analysis (g)	Chloride Content by Dry Wt. of Sample (%)
Control Dust	**129673D**	**-**	**1.7891**	**0.12**
T1/44511 - 5891/19	145585A	0-3	1.9620	0.01
	145585B	0-3	1.9855	0.01
T1/44511 - 5891/20	145586A	0-3	2.0794	0.02
	145586B	0-3	1.9712	0.02
T1/44511 - 5891/21	145587A	0-3	1.8770	0.02
	145587B	0-3	1.9153	0.02
T1/44511 - 5891/22	145588A	0-3	1.4104	0.01
	145588B	0-3	1.5918	0.01
T1/44511 - 5891/23	145589A	0-3	1.7016	0.01
	145589B	0-3	1.7952	0.01
T1/44511 - 5891/24	145590A	0-3	2.1979	0.02
	145590B	0-3	2.0191	0.02
T1/44511 - 5891/25	145591A	0-3	1.7226	0.01
	145591B	0-3	1.8715	0.01
T1/44511 - 5891/26	145592A	0-3	1.8399	0.02
	145592B	0-3	1.9455	0.02
T1/44511 - 5891/27	145593A	0-3	1.9401	0.01
	145593B	0-3	1.8008	0.01
T1/44511 - 5891/28	145594A	0-3	1.8296	0.01
	145594B	0-3	1.8163	0.01
Control Dust	**127633E**	**-**	**1.7392**	**0.13**
T1/44511 - 5891/29	145595A	0-3	1.4511	0.01
	145595B	0-3	1.4100	0.01
T1/44511 - 5891/30	145596A	0-3	1.6441	0.01
	145596B	0-3	1.7745	0.01
T1/44511 - 5891/31	145597A	0-3	1.5982	0.01
	145597B	0-3	1.7313	0.01
T1/44511 - 5891/32	145598A	0-3	1.8605	0.01
	145598B	0-3	1.8560	0.01
T1/44511 - 5891/33	145599A	0-3	2.1632	0.02
	145599B	0-3	2.1581	0.01
T1/44511 - 5891/34	145600A	0-3	1.8004	<0.01
	145600B	0-3	1.8983	<0.01
T1/44511 - 5891/35	145601A	0-3	1.8714	0.01
	145601B	0-3	1.9090	0.01
T1/44511 - 5891/36	145602A	0-3	2.0389	0.01
	145602B	0-3	2.0298	0.01
Control Dust	**127633F**	**-**	**1.5849**	**0.12**

Date samples tested: 11 Feb 2010

END OF CERTIFICATE

TC-N950-TEMP-066(A)