Chloride Removal Using "Recyclable Encapsulated Abrasive Media"

Michael Merritt, Sponge-Jet, Inc.

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CHLORIDE REMOVAL
USING "RECYCLABLE ENCAPSULATED ABRASIVE MEDIA"

Michael Merritt

Sponge-Jet, Inc
Portsmouth, NH USA

ABSTRACT:

This paper presents results of multiple test programs that have been performed to determine the effectiveness of recyclable encapsulated abrasive media to remove chlorides during surface preparation. Tests published in 2002 concluded that this technology consistently achieves significant reductions of chloride levels in comparison to those achieved with conventional abrasive blasting. However, those tests were conducted with new media and not recycled media; leaving questions regarding the effect of recycling and possible re-deposition of contaminates on the surface.

Recent tests indicate that chloride removal can be efficiently performed while recycling encapsulated abrasive media and no detrimental effect on removal rates occurs with increased recycles; in fact, increased cycles showed a slight improvement in removal efficacy. Test results also indicate that blasting with encapsulated abrasive media can frequently reduce chloride concentrations to below typically specified levels. This process compares favorably in both cost and speed to other technologies, which often require a multi-step procedure such as abrasive blast, water or chemical wash and final abrasive blast to achieve specified levels of surface contaminants.

BACKGROUND INFORMATION ON ENCAPSULATED ABRASIVE MEDIA

Encapsulated Abrasive Media was invented in the late 80's and has grown in use as an accepted form of abrasive blasting since that time. It is referred to under many other names such as Pliant Media, Composite Media, Sponge Media and Sponge Blasting. The heart of this technology is combining abrasives with an open cell polyurethane sponge-like material. (Fig 1)

Fig 1: Close up of Encapsulated Abrasive Media
Photo Courtesy Sponge-Jet, Inc; Portsmouth, NH

The advantage of this composite material is that the sponge-like particles flatten on impact, exposing the abrasive and profile the surface just like conventional abrasive blasting. When rebounding from the surface, sponge media expands, creating a vacuum, cleaning the surface and entrapping most of what would normally have become airborne contaminants.

The combination of the encapsulated abrasive media along with a suitable blasting device and recycling system (Fig 2 & 3) allows this technology to prepare surfaces in the same manner as conventional abrasive blasting, but leaving the prepared surface cleaner than does conventional blasting. This technology also allows greater visibility, less dust, less waste and less ricochet damage to its surroundings.

Fig 2: Blasting Device
(Pressure Vessel or Feed Unit)

Fig 3: Recycler
Photos Courtesy Sponge-Jet, Inc

Recycling procedures are critical to assuring quality results. SSPC has recently released its abrasive quality standard for these types of materials: ***SSPC AB4 Recyclable Encapsulated Abrasive Media*** which defines acceptable recycling procedures.

BACKGROUND INFORMATION ON RESIDUAL CHLORIDE AND CHLORIDE REMOVAL

The effect of residual chlorides on a coated substrate has been of increasing interest over the last two decades. A greater understanding of coating performance and the correlation between the level of surface cleanliness and the expected life of the coating system has become more widely recognized. Many however, still debate what levels of residual chlorides, salts and other contaminates should be allowed to remain on a surface prior to coating.

NOTE: All units reported for chloride levels in this article have been converted to mg/m^2 to simplify comparison. The actual standards referenced may report in different units.

U.S. NAVY

The U.S. Navy began limiting the thresholds for residual chlorides in the early 1990s, which required 100 mg/m^2 on non-immersion substrates and 50 mg/m^2 on immersed substrates. Fewer than ten years later, the U.S. Navy lowered acceptable thresholds for residual chlorides to 50 mg/m^2 (NFGS-09971E) on non immersion substrates and 30 mg/m^2 (NFGS-09970F) on immersed substrates.

SSPC

As recently as 2000 the industrial coatings industry through SSPC, established "Non-visual Surface Preparation Definitions" which recognize three standard "Conditions" or levels of surface cleanliness. (Table 1)[i]

Table 1 - Non-visual Surface Preparation Definitions	
SSPC SC1	Free of detectable Chloride levels
SSPC SC2	<70 mg/m^2 Residual Chlorides
SSPC SC3	<500 mg/m^2 Residual Chlorides

International Marine Organization (IMO)

Illustrating the diversity of chloride specifications throughout the world, the Republic of South Korea published a document[III] through the IMO showing the range of different chloride levels suggested from 12 different sources (Fig 4).

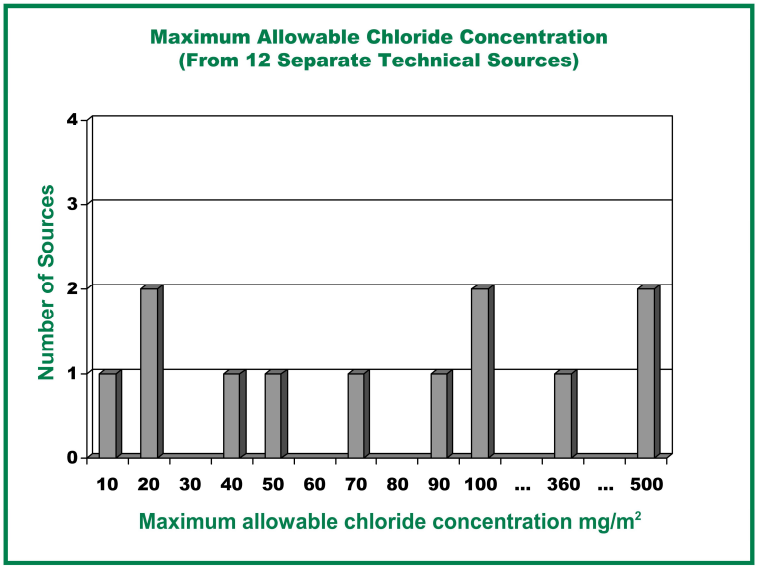

Fig 4

CHLORIDE REMOVAL METHODS

Despite the diverse range of recommendations for residual chloride levels, surface preparation professionals must have the tools and procedures to cost-effectively achieve the specified result. While abrasive blasting certainly removes some chlorides, it does not consistently lower residual chloride values to acceptable limits without the use of water or chemical rinsing. This process often involves multiple cycles of blasting, rinsing and re-blasting or requires the use of ultra-high pressure water to remove coatings and contaminates followed by abrasive blasting to achieve the specified profiles. **Recyclable encapsulated abrasive media** is promoted as an alternative method which can achieve specified chloride levels in a single process without water or chemical rinse.

VIRGIN (NON RECYCLED) ENCAPSULATED ABRASIVE MEDIA

The first known evaluation of encapsulated abrasive media to remove chlorides was conducted by a high performance coating manufacturer in 1997 when qualifying the use of that process as a suitable method of surface preparation for their coatings. They determined that a single blast with a certain encapsulated abrasive media could lower chloride levels from 1,000 mg/m^2 to less than 10 mg/m^2. By comparison they had to do an abrasive blast with aluminum oxide, water rinse, allow flash rusting and re-blast to achieve the same results with conventional blasting (Fig 5).

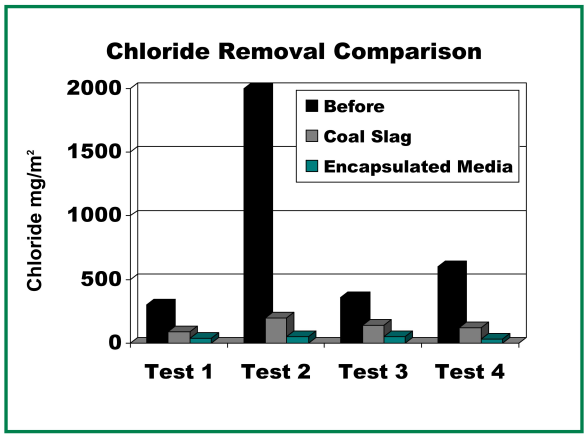

Fig 5:

Since that time, other tests and a variety of field applications have taken place where encapsulated abrasive media was used to prepare surfaces and achieve chloride levels below commonly specified levels in one step, without the use of water, chemical washing or re-blasting. A compendium of tests and case histories detailing these results was presented and published for the 2001 SSPC trade show[I], which included the following results in Fig 5 and Table 2.

TABLE 2– RESIDUAL CHLORIDE TEST:[II]

Chloride Before	After Blasting With Coal Slag	After Blasting With Encapsulated Media
300mg/m^2	90mg/m^2	40 mg/m^2
2000 mg/m^2	200 mg/m^2	50 mg/m^2
360mg/m^2	140 mg/m^2	50 mg/m^2
600mg/m^2	120 mg/m^2	30 mg/m^2

The above data demonstrates in all tested levels of pre-contamination, the sections blasted with encapsulated abrasive media consistently removed chlorides at or below 50 mg/m^2, while the sections blasted with coal slag ranged from 90 mg/m^2 to 200 mg/m^2. This data clearly supports the ability of encapsulated abrasive media (or pliant media as it was referred to in the original report) to achieve significant reductions in chloride levels in comparison to those achieved with conventional abrasives.

RECYCLING OF MEDIA

The results reported in TABLE 2 utilized virgin Encapsulated Abrasive Media and therefore did not include recycling activity. Case histories reported in the 2002 article indicated excellent results with chloride removal while recycling the Encapsulated Abrasive Media, but due to limited controls and documentation they could not be considered conclusive.

In early 2009, prior to a large offshore project, an offshore services company for PETRONAS (Malaysian National Oil Company) contracted a test lab SIRM QAS International and a NACE II Inspector to conduct a series of rigorous tests. The offshore services company wanted to determine if this method of surface preparation could be reliably used to lower chloride levels on offshore structures to below 25 mg/m^2, which would meet the PATRONAS standard specification. Secondly, they needed to get approval of the PATRONAS engineering staff to accept this technology as a method for chlorides removal and to gain approval for general surface preparation. These tests were intended to (1) quantify Recyclable Encapsulated Abrasive Media's ability to lower residual chloride levels on the surface, (2) determine if the recycling of this media would raised the chloride level of the media and (3) provide documentation of the surface profile achieved for ultimate qualification by PATRONAS.

TEST PROTOCALL

The test protocol involved the contamination of a series of test panels, which had varying surface conditions (Rust Grade C, Grade A, existing high build marine coatings). Chloride levels were determined by ISO 8502-6:1995 Bresle Method to be an average of 82 mg/m^2 on these test plates. A one square foot (0.1 m^2) panel was then blasted to a visual surface cleanliness of SA 2½ and the remaining abrasive in the pressure vessel expended on an equally contaminated larger plate. The media was recovered, recycled and a second test blast was conducted on a second plate. This process was repeated for 7 cycles representing a typical recycle rate used on offshore structures. Appendix A of this Article includes the full text, photos and data of the SIRM Report.

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/007/09
METHOD	BRESLE TEST METHOD – ISO8502-6
SUBSTRATE	Test Panel
PROJECT TITTLES	Sponge Jet Sirim's Test-Chloride Test
ABRASIVE	Sponge Jet Silver 30 (Aluminium Oxide)
ABRASIVE CONDITION	6 Times Recycle
SURFACE PROFILE	25µm – 70µm
RUST GRADE	Grade C
SURFACE TEMPERATURE	30°C
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	18 MAC 2009 @ 1700HRS

TEST RESULT

Test Panel No.	Chloride Test	Remarks
No. 7	9 mg/m²	Acceptable

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m² or 25ppm.
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Remarks: For the test panel number 1 & 2 the result was inaccurate due to moisture leaking in after cooler unit. Should the defect was rectified for test plate number 3 onwards, the result was in acceptance level.

Conducted by:	*Witnessed by:*	*Approved by:*
Irwinzam Painting Inspector NACE Level II Certified	En. Mazrin Representative Tanjung Offshore Services S/B	En. Aziz Representative SIRIM SB

ABDUL AZIZ HARON
Senior Technical Executive
Chemical & Consumer Section
SIRIM QAS International Sdn. Bhd.

Fig 6: See Attached Appendix for full report.

TEST RESULTS

The test protocol was carried out on April 17, 2009 under careful supervision of the SIRIM QAS Sdn. Bhd, a NACE certified Inspector and a representative of the offshore services contractor Tanjung Offshore Services. During the testing an issue developed with the first two panels tested, where unexpectedly high readings were recorded. Further investigation revealed that a leak in an after cooler unit caused cross contamination of chloride laden water on the panels. These test results were rejected and are shown below as an "Error".

Summary of the data is below:

TABLE 3 SIRM TEST		Surface Test Bresle	Abrasive Media Test Kitagawa Tube
Test Panel	**Sponge Recycles**	**Plate mg/m2 (25 max allowable)**	**Chloride level**
Control	**Not Blasted**	**82**	15
1	New	Error	20
2	1	Error	
3	2	14.5	
4	3	14.5	
5	4	11.5	
6	5	11	52
7	6	9	

NOTE: The data from the first two blast cycles was later found to be in accurate due to some cross contamination of salt laden water due to a leak in an after cooler unit.

The test results above in Table 3 clearly demonstrate that during the recycling process some of the chloride contaminates remained in the sponge media after recycling. Chloride measurements of the media grew from 15 for new media to 20 for the first cycle and then to 52 for 5 recycles. However, consistent with previously reported case histories this "residual" chloride content in the media itself did not appear to impair the cleaning effectiveness. To the surprise of all participants, the residual chlorides on the test panels after blasting decreased with additional cycles. In other words, "Cleaning efficiency improved with reuse and recycling of the Recyclable Encapsulated Abrasive Media". This finding is theorized to be due to the smaller particles of recycled material providing a more uniform blast pattern and thus a better scouring of the entire surface. Normal recycling procedures would require the addition of 5-10% new media with each cycle to provide a uniform working mix (new and recycled media) is utilized.

Based on these results, the Offshore Services Contractor and PATRONAS were satisfied that Encapsulated Abrasive Media could be recycled and still achieve the high chloride removal results required. This enables contractors to perform the paint removal, surface profiling, blasting to Sa 2 ½ visual cleanliness and chloride removal below the specified 25 mg/m^2 all in one step. Further noted benefits were that the low dust and ricochet of this process would now enable the contractor to work while facilities are online or if during a shut down while other trades carry out critical maintenance in close proximity.

CONCLUSION

Prior independent testing, field experience and new data from the offshore industry confirm that surface preparation with Encapsulated Abrasive Media, provides superior cleaning as compared to traditional abrasive blasting. Furthermore, the ability to reach specified levels in a one-step process is possible in the majority of applications. Recyclable Encapsulated Abrasive Media, when used to remove chlorides, does retain a portion of chloride contaminants in its porous structure. Using material recycled on a project that contained chlorides and using it on another project where the substrate was chloride free would not be advisable – due to the risk of chloride cross-contamination. However, on projects where surfaces are laden with chlorides, Recyclable Encapsulated Abrasive Media is a reliable and increasingly accepted method to prepare the surface in a single dry step.

APPENDIX:

SIRIM QAS International Sdn.Bhd. (Company No.: 410334-X)
CHEMICAL TESTING SECTION, Building 16, No.1, Persiaran Dato' Menteri, P O Box 7035, Section 2, 40911 Shah Alam, Selangor Darul Ehsan, Malaysia
Tel no: 03-55446651/55446658 Fax no: 03-55446688

TEST REPORT

REPORT NO. : 2009KL0525	PAGE : 1 OF 2

Applicant	:	TANJUNG OFFSHORE SERVICES SDN. BHD. No. 8-3, Jalan Puncak Setiawangsa 4, Taman Setiawangsa, 54200 Kuala Lumpur, Malaysia
Manufacturer	:	SPONGE – JET, INC 235 Heritage Avenue, Suite 2, Portsmouth, NH 03801 (USA)
Product	:	Abrasive Blasting
Reference standard / Method of Test	:	1) ISO 8502-6:1995 Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness – Part 6: Extraction of soluble contaminants for analysis -- The Bresle method 2) ASTM D7091-05 Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals 3) ISO 8503-5:2003 Preparation of steel substrates before application of paints and related products -- Surface roughness characteristics of blast-cleaned steel substrates - Part 5: Replica tape method for the determination of the surface profile
Description of sample	:	Tested and witnessed on-site Sponge-Jet Dry Abrasive Blasting System on coated and rusted Steel Panels prepared by applicant which were labeled and described in detail as per Appendix of this test report: **Other Testing Information**: Test Location: Tanjung Maintenance Services Sdn.Bhd. Lot D1,Kaw.MIEL Teluk Kalong, 24007 Kemaman, Terengganu, Malaysia 1. The demonstration was carried on 26th February 2009 for Chloride test on new Sponge Jet Silver 30 (Aluminium Oxide) Abrasive using Kitagawa Tube Test and the performance of the Sponge-Jet Dry Abrasive Blasting System at above mentioned test site with the presence of all personnel concerned. 2. Another demonstration was conducted on 18th March 2009 also at same test location as mentioned above to determine soluble/chloride contamination on the blasted substrate by using The Bresle method for Test Panel No. 1, 2, 3, 4, 5, 6, and 7 incorporation with conductivity test for fresh and recycle media with the presence of all personnel concerned.
Date tested	:	18th March 2009
Job No.	:	J20095080503
Issue date	:	20th April 2009

Approved Signatory

(ABDUL AZIZ HARON)
Senior Technical Executive

for (HAHNAS MAHBUT)
Head
Chemical & Consumer Section (CEST),
Testing Services Department

TEST REPORT

REPORT NO. : 2009KL0525	PAGE : 2 OF 2

Test Results

Sample	**: Abrasive Blasting**
Brand	**: Sponge – Jet®**
Model	**: 100 HP & 400 HP Sponge – Jet® High Production Feed Units** **35P & 35-E Sponge – Jet® Recyclers** **B-VAC PRO 2 – Integrated Sponge Blasting ™ System**
Test Method	**: ISO 8502-6:1995 Preparation of steel substrates before application of paints and related products - Tests for the assessment of surface cleanliness – Part 6: Extraction of soluble contaminants for analysis - The Bresle method**

The test results are as in the attachment.

ABDUL AZIZ HARON
Senior Technical Executive
Chemical & Consumer Section
SIRIM QAS International Sdn. Bhd

ATTACHMENT

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/001/09
METHOD	BRESLE TEST METHOD – ISO8502-6
SUBSTRATE	Test Panel
PROJECT TITTLES	SIRIM QAS – Bresle Method (ISO 8502-6) Sponge Jet Chloride Test
ABRASIVE	Silver 30 Sponge Media (Aluminium Oxide)
ABRASIVE CONDITION	Fresh/ New
SURFACE PROFILE	45µm – 65µm
RUST GRADE	Grade C
SURFACE TEMPERATURE	32°C
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	18 MAC 2009 @ 1130HRS

TEST RESULT

Test Panel No.	Chloride Test	Remarks
No. 1	**22 mg/m²**	**Acceptable**

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m².
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Remarks: For the test panel number 1 & 2 the result was inaccurate due to moisture leaking in after cooler unit. Should the defect was rectified for test plate number 3 onward the result was in acceptance level.

Conducted by :

Irwinzam Mohd Noor
Painting Inspector
NACE Level II Certified

Witnessed by:

En. Mazrin Ramli
Representative
Tanjung Offshore Services

Approved by:

En. Abdul Aziz Haron
Representative
SIRIM QAS International

ABDUL AZIZ HARON
Senior Technical Executive
Chemical & Consumer Section
SIRIM QAS International Sdn. Bhd.

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/002/09
METHOD	BRESLE TEST METHOD – ISO8502-6
SUBSTRATE	Test Panel
PROJECT TITTLES	SIRIM QAS – Bresle Method (ISO 8502-6) Sponge Jet Chloride Test
ABRASIVE **ABRASIVE CONDITION**	Silver 30 Sponge Media (Aluminium Oxide) 1 Times Recycle
SURFACE PROFILE	42µm – 55µm
RUST GRADE	Grade C
SURFACE TEMPERATURE	34°C
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	18 MAC 2009 @ 1210HRS

TEST RESULT

Test Panel No.	Chloride Test	Remarks
No. 2	**43.5 mg/m²**	**Non acceptable**

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m².
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Remarks: For the test panel number 1 & 2 the result was inaccurate due to moisture leaking in after cooler unit. Should the defect was rectified for test plate number 3 on wards, the result was in acceptance level.

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Painting Inspector
NACE Level II Certified

Witnessed by:

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Representative
Tanjung Offshore Services

Approved by:

En. Abdul Aziz Haron
Representative
SIRIM QAS International

ABDUL AZIZ HARON
Senior Technical Executive
Chemical & Consumer Section
SIRIM QAS International Sdn. Bhd.

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/003/09
METHOD	BRESLE TEST METHOD – ISO8502-6
SUBSTRATE	Test Panel
PROJECT TITTLES	SIRIM QAS - Bresle Method (ISO 8502-6) Sponge Jet Chloride Test
ABRASIVE	Silver 30 Sponge Media (Aluminium Oxide)
ABRASIVE CONDITION	2 Times Recycle
SURFACE PROFILE	50µm – 120µm
RUST GRADE	Grade C
SURFACE TEMPERATURE	34°C
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	18 MAC 2009 @ 1345HRS

TEST RESULT

Test Panel No.	Chloride Test	Remarks
No. 3	14.5 mg/m²	Acceptable

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m².
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Remarks: For the test panel number 1 & 2 the result was inaccurate due to moisture leaking in after cooler unit. Should the defect was rectified for test plate number 3 on wards, the result was in acceptance level.

Conducted by :	*Witnessed by:*	*Approved by:*
Irwinzam Mohd Noor	**En. Mazrin Ramli**	**En. Abdul Aziz Haron**
Painting Inspector	**Representative**	**Representative**
NACE Level II Certified	**Tanjung Offshore Services**	**SIRIM QAS International**

ABDUL AZIZ HARON
Senior Technical Executive
Chemical & Consumer Section
SIRIM QAS International Sdn. Bhd.

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/004/09
METHOD	BRESLE TEST METHOD – ISO8502-6
SUBSTRATE	Test Panel
PROJECT TITTLES	SIRIM QAS – Bresle Method (ISO 8502-6) Sponge Jet Chloride Test
ABRASIVE	Silver 30 Sponge Media (Aluminium Oxide)
ABRASIVE CONDITION	3 Times Recycle
SURFACE PROFILE	52µm – 110µm
RUST GRADE	Grade C
SURFACE TEMPERATURE	34°C
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	18 MAC 2009 @ 1510HRS

TEST RESULT

Test Panel No.	Chloride Test	Remarks
No. 4	14.5 mg/m²	Acceptable

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m² or 25ppm.
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Remarks: For the test panel number 1 & 2 the result was inaccurate due to moisture leaking in after cooler unit. Should the defect was rectified for test plate number 3 onward the result was in acceptance level.

Conducted by:

Irwinzam Mohd Noor
Painting Inspector
NACE Level II Certified

Witnessed by:

En. Mazrin Ramli En.
Representative
Tanjung Offshore Services

Approved by:

Abdul Aziz Haron
Representative
SIRIM QAS International

ABDUL AZIZ HARON
Senior Technical Executive
Chemical & Consumer Section
SIRIM QAS International Sdn. Bhd.

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/005/09
METHOD	BRESLE TEST METHOD – ISO8502-6
SUBSTRATE	Test Panel
PROJECT TITTLES	SIRIM QAS – Bresle Method (ISO 8502-6) Sponge Jet Chloride Test
ABRASIVE	Silver 30 Sponge Media (Aluminium Oxide)
ABRASIVE CONDITION	4 Times Recycle
SURFACE PROFILE	50µm – 75µm
RUST GRADE	Grade C
SURFACE TEMPERATURE	34°C
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	18 MAC 2009 @ 1530HRS

TEST RESULT

Test Panel No.	Chloride Test	Remarks
No. 5	11.5 mg/m²	Acceptable

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m² or 25ppm.
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Remarks: For the test panel number 1 & 2 the result was inaccurate due to moisture leaking in after cooler unit. Should the defect was rectified for test plate number 3 onward the result was in acceptance level.

Conducted by:

Irwinzam Mohd Noor
Painting Inspector
NACE Level II Certified

Witnessed by:

TANJUNG OFFSHORE SERVICES SDN BHD (100697-T) Kuala Lumpur

En. Mazrin Ramli
Representative
Tanjung Offshore Services

Approved by:

SIRIM QAS International Sdn. Bhd.

En. Abdul Aziz Haron
Representative
SIRIM QAS International

ABDUL AZIZ HARON
Senior Technical Executive
Chemical & Consumer Section
SIRIM QAS International Sdn. Bhd.

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/006/09
METHOD	BRESLE TEST METHOD - ISO8502-6
SUBSTRATE	Test Panel
PROJECT TITTLES	Sponge Jet Sirim's Test-Chloride Test
ABRASIVE	Sponge Jet Silver 30 (Aluminium Oxide)
ABRASIVE CONDITION	5 Times Recycle
SURFACE PROFILE	48µm - 70µm
RUST GRADE	Grade C
SURFACE TEMPERATURE	32°C
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd..
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	18 MAC 2009 @ 1630HRS

TEST RESULT

Test Panel No.	Chloride Test	Remarks
No. 6	**11 mg/m²**	**Acceptable**

Notes:
1) Acceptance criteria - 50µS/cm or 25mg/m² or 25ppm.
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Remarks: For the test panel number 1 & 2 the result was inaccurate due to moisture leaking in after cooler unit. Should the defect was rectified for test plate number 3 onward, the result was in acceptance level.

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Irwinzam	**En. Mazrin**	**En. Aziz**
Painting Inspector	**Representative**	**Representative**
NACE Level II Certified	**Tanjung Offshore Services S/B**	**SIRIM SB**

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/007/09
METHOD	BRESLE TEST METHOD – ISO8502-6
SUBSTRATE	Test Panel
PROJECT TITTLES	Sponge Jet Sirim's Test-Chloride Test
ABRASIVE	Sponge Jet Silver 30 (Aluminium Oxide)
ABRASIVE CONDITION	6 Times Recycle
SURFACE PROFILE	25µm – 70µm
RUST GRADE	Grade C
SURFACE TEMPERATURE	30°C
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	18 MAC 2009 @ 1700HRS

TEST RESULT

Test Panel No.	Chloride Test	Remarks
No. 7	**9 mg/m²**	**Acceptable**

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m² or 25ppm.
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Remarks: For the test panel number 1 & 2 the result was inaccurate due to moisture leaking in after cooler unit. Should the defect was rectified for test plate number 3 onwards, the result was in acceptance level.

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Irwinzam	**En. Mazrin**	**En. Aziz**
Painting Inspector	**Representative**	**Representative**
NACE Level II Certified	**Tanjung Offshore Services S/B**	**SIRIM SB**

ABDUL AZIZ HARON
Senior Technical Executive
Chemical & Consumer Section
SIRIM QAS International Sdn. Bhd.

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/008/09
METHOD	BRESLE TEST METHOD – ISO8502-6
PROJECT TITTLES	SIRIM QAS – Bresle Method (ISO 8502-6) Sponge Jet Chloride Test
SUBSTRATE	Test Panel
SUBSTRATE CONDITION **RUST GRADE**	Non Blasted surface Grade C
SURFACE TEMPERATURE	31°C
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS **DATE OF TEST**	Tanjung Maintenance Services Kemaman 18 MAC 2009 @ 1050HRS

TEST RESULT

Test Panel No.	Chloride Test	Remarks
Non Blasted Panel Grade C	**82 mg/m²**	**Control measurement References for Test Panel No.1 ~ No.7**

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m² or 25ppm.
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Conducted by:	*Witnessed by:*	*Approved by:*
Irwinzam Mohd Noor **Painting Inspector** **NACE Level II Certified**	**En. Mazrin Ramli** **Representative** **Tanjung Offshore Services**	**En. Abdul Aziz Haron** **Representative** **SIRIM QAS International**

ABDUL AZIZ HARON
Senior Technical Executive
Chemical Technology Division
SIRIM QAS International Sdn. Bhd.

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/009/09
METHOD	Kitagawa Tube
PROJECT TITTLES	SIRIM QAS – Bresle Method (ISO 8502-6) Sponge Jet Chloride Test
ABRASIVE	Silver 30 Sponge Media (Aluminium Oxide)
ABRASIVE CONDITION	Fresh/ New
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	18 MAC 2009 @ 1100HRS

TEST RESULT

Abrasive	Chloride Test	Remarks
Fresh/ New Silver 30 Sponge Media	**15 mg/m²**	**Acceptance criteria only applicable for chloride value on the substrate.**

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m² or 25ppm.
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Conducted by:	*Witnessed by:*	*Approved by:*
Irwinzam Mohd Noor **Painting Inspector** **NACE Level II Certified**	**En. Mazrin Ramli** **Representative** **Tanjung Offshore Services**	**En. Abdul Aziz Haron** **Representative** **SIRIM QAS International**

ABDUL AZIZ HARON
Senior Technical Executive

CHLORIDE TEST REPORT

REPORT NO	CTR/IMN/010/09
METHOD	Kitagawa Tube
PROJECT TITTLES	SIRIM QAS – Bresle Method (ISO 8502-6) Sponge Jet Chloride Test
ABRASIVE	Silver 30 Sponge Media (Aluminium Oxide)
ABRASIVE CONDITION	5 Times Recycle
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	18 MAC 2009 @ 1645HRS

TEST RESULT

Abrasive	Chloride Test	Remarks
5 Times Recycle	**52 mg/m²**	**Acceptance criteria only applicable for chloride value on the substrate.**

Notes:
1) Acceptance criteria – 50µS/cm or 25mg/m² or 25ppm.
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Conducted by:	*Witnessed by:*	*Approved by:*
Irwinzam Mohd Noor	**En. Mazrin Ramli**	**En. Abdul Aziz Haron**
Painting Inspector	**Representative**	**Representative**
NACE Level II Certified	**Tanjung Offshore Services**	**SIRIM QAS International**

ABDUL AZIZ HARON
Senior Technical Executive
Chemical & Corrosion Section
SIRIM QAS International Sdn. Bhd.

CHLORIDE TEST REPORT FOR ABRASIVE

REPORT NO	CTR/IMN/011/09
METHOD	Kitagawa Tube Test
PROJECT TITTLES	Sponge Jet Sirim's Test-Chloride Test
ABRASIVE	Sponge Jet Silver 36 (Aluminium Oxide)
ABRASIVE CONDITION	Fresh/ New
WITNESSES PARTY	Tanjung Offshore Services Sdn. Bhd.
APPROVE PARTY	SIRIM QAS International Sdn. Bhd.
LOCATION AREAS	Tanjung Maintenance Services Kemaman
DATE OF TEST	26TH FEBRUARY @ 1000Hrs

TEST RESULT

Test Panel No.	Chloride Test	Remarks
No. 1	**20 mg/m²**	**Acceptable**

Notes:
1) Acceptance criteria - 50µS/cm or 25mg/m².
2) Test are taken randomly and the results serve as a guide only owing to concentration and distribution of chloride may not be uniform throughout the substrates.
3) This test report is prepared on the inspection made dated above and to our best knowledge and is issued without prejudice.

Conducted by:	*Witnessed by:*	*Approved by:*
Irwinzam	**En. Mazrin**	**En. Aziz**
Painting Inspector	**Representative**	**Representative**
NACE Level II Certified	**Tanjung Offshore Services S/B**	**SIRIM S/B**
		ABDUL AZIZ HARON Senior Technical Executive Chemical & Consumer Section SIRIM QAS International Sdn. Bhd.

INSPECTION REPORT
(Sponge Media Dry Abrasive Blasting)

Project Title	SIRIM QAS – Bresle Method (ISO 8502-6) Sponge Jet Chloride Test	Report No.	IR/IMN/001
Application Area	Tanjung Maintenance Services Sdn. Bhd. Teluk Kalong		
Description	Test Panel No.1		

Date & Time / Weather	Blasting		1st Coat		2nd Coat		3rd Coat	
	26Feb	0905Hrs						
Air Temp (°C)	27.5							
Wet Bulb Temp (°C)	25.5							
ZRelative Humidity (%)	85							
Steel Temp (°C)	28							
Dew Point (°C)	24							
Paint System (Product)								
Colour								
Batch Number								
Specified Dry Film Thickness (m)								

SURFACE PREPARATION

Method	Panel Condition	Standard Cleanliness	Type of Abrasive	Surface Profile	Duration of Blasting
Manual Blast	Existing old coating thickness 800-1200µm	Sa 2.5	Silver ~~2016~~ Sponge Media (Aluminium Oxide)	80-120 µm	80Sec

No	Description	Dry Film Thickness (µm)												Average
		1st Coat			2nd Coat			3rd Coat			4th Coat			
	Test Panel No: 1													

Prepared by:	Verified by:	Approved by:
Painting Inspector	Tanjung Offshore Services Sdn.Bhd.	SIRIM QAS Sdn.Bhd.
Name: Irwinzam Mohd Noor	Name: En Mazrin Ramli	Name: En Abd Aziz Haron
Date: 17/04/09	Date: 17/04/09	Date: 17/04/09

INSPECTION REPORT
(Sponge Media Dry Abrasive Blasting)

Project Title	SIRIM QAS – Brestle Method (ISO 8502-6) Sponge Jet Chloride Test	Report No.	IR/IMN/002
Application Area	Tanjung Maintenance Services Sdn. Bhd. Teluk Kalong		
Description	Test Panel No.2		

Date & Time / Weather	Blasting	1st Coat	2nd Coat	3rd Coat
	26Feb 1036Hrs			
Air Temp (°C)	28.5			
Wet Bulb Temp (°C)	26			
ZRelative Humidity (%)	82			
Steel Temp (°C)	29			
Dew Point (°C)	25			
Paint System (Product)				
Colour				
Batch Number				
Specified Dry Film Thickness (m)				

SURFACE PREPARATION

Method	Panel Condition	Standard Cleanliness	Type of Abrasive	Surface Profile	Duration of Blasting
Manual Blast	Existing old coating thickness 800-1400µm	Sa 2.5	Silver ~~3016~~ Sponge Media (Aluminium Oxide)	150-250 µm	184Sec

No	Description	Dry Film Thickness (µm) 1st Coat	2nd Coat	3rd Coat	4th Coat	Average
	Test Panel No: 2					

Prepared by:	Verified by:	Approved by:
Painting Inspector	Tanjung Offshore S/B	SIRIM S/B
Name: Irwinzam Mohd Noor	Name: En Mazrin Ramli	Name: En Abd Aziz Haron
Date: 17/04/09	Date: 17/04/09	Date: 17/04/09

INSPECTION REPORT
(Sponge Media Dry Abrasive Blasting)

Project Title	SIRIM QAS – Brestle Method (ISO 8502-6) Sponge Jet Chloride Test	Report No.	IR/IMN/003
Application Area	Tanjung Maintenance Services Sdn. Bhd.		
Description	Test Panel No.3		

Date & Time / Weather	Blasting		1st Coat		2nd Coat		3rd Coat	
	26Feb	1129Hrs						
Air Temp (°C)	31							
Wet Bulb Temp (°C)	27							
ZRelative Humidity (%)	73							
Steel Temp (°C)	29							
Dew Point (°C)	26							
Paint System (Product)								
Colour								
Batch Number								
Specified Dry Film Thickness (µm)								

SURFACE PREPARATION

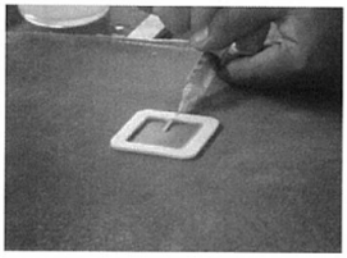
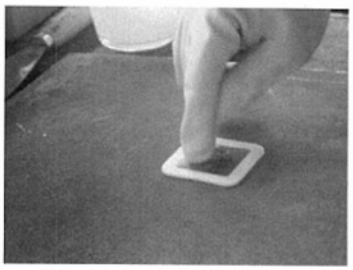
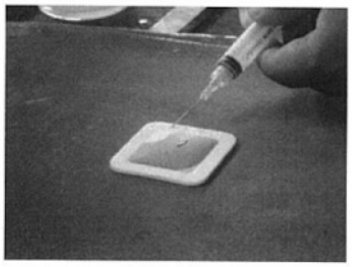
Method	Panel Condition	Standard Cleanliness	Type of Abrasive	Surface Profile	Duration of Blasting
Manual Blast	Rust Grade A	Sa 2.5	Silver ~~3016~~ Sponge Media (Aluminium Oxide)	110-260 µm	112Sec

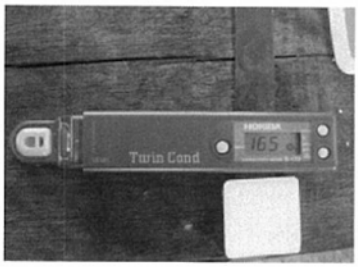
No	Description	Dry Film Thickness (µm)												Average
		1st Coat			2nd Coat			3rd Coat			4th Coat			
	Test Panel No: 3													

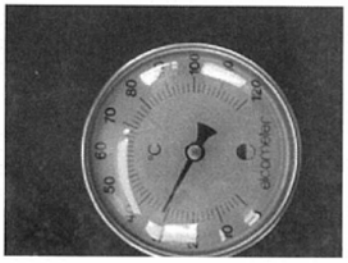
Prepared by:	Verified by:	Approved by:
Painting Inspector	Tanjung Offshore Services Sdn Bhd	SIRIM QAS Sdn Bhd
.....	.....	.....
Name: Irwinzam Mohd Noor	Name: En Mazrin Ramli	Name: En Abd Aziz Haron
Date: 17/04/09	Date: 17/04/09	Date: 17/04/09

Chloride Test on Rusted Plate Grade C

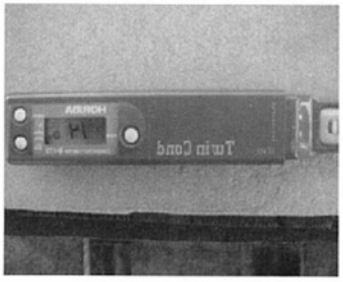
Before Blast

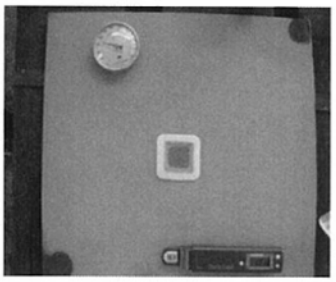
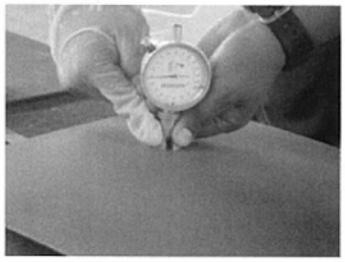








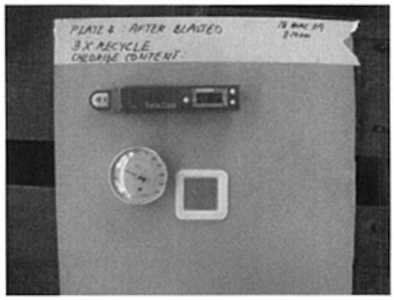
After Blast with Fresh Media

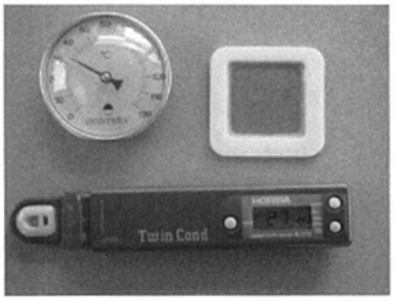


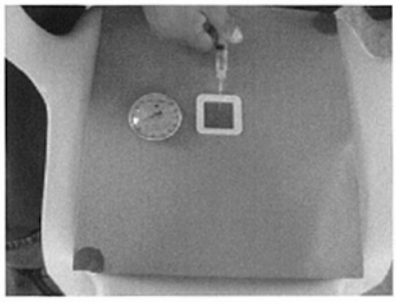



Chloride Test on Rusted Plate Grade C

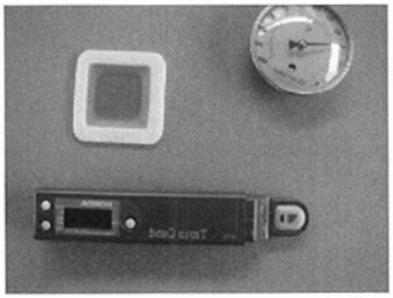
After 3 Times Recycle

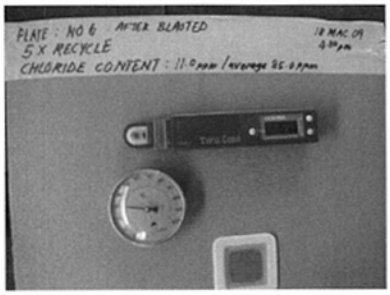


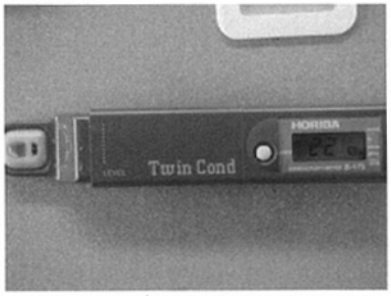


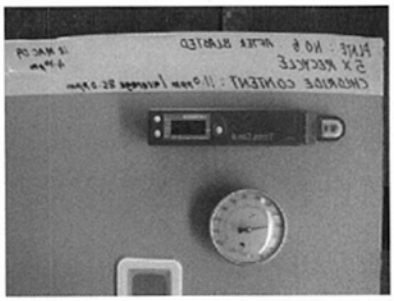


After 5 Times Recycle

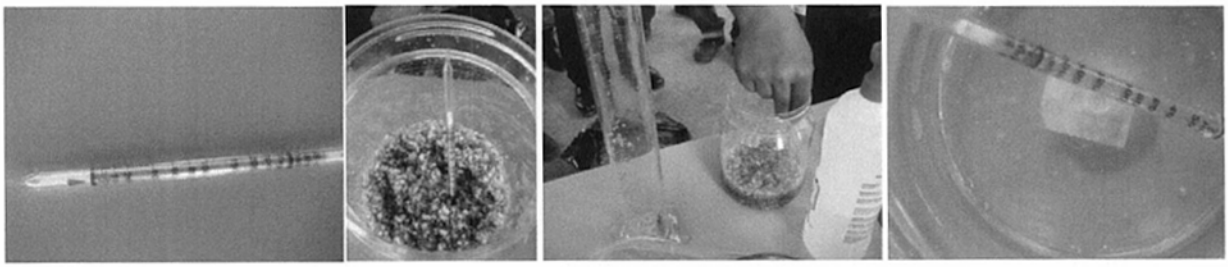


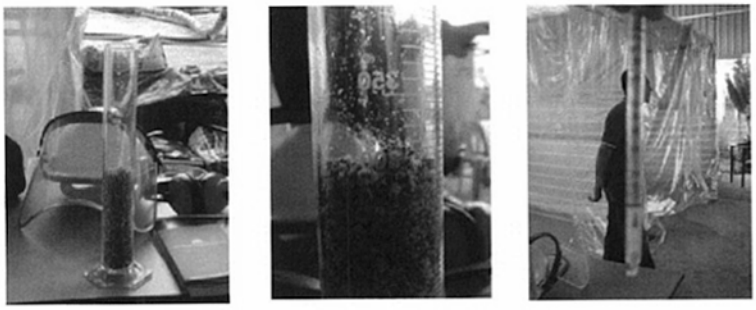






Chloride Test





Document Title

BRESLE TEST PROCEDURE FOR SPONGE JET ABRASIVE BLASTING SYSTEM

Document Number: TOS/MCIM/IP/01 – Rev 1 170309

Company's Address and contact details:
Material, Corrosion, Inspection and Maintenance (MCIM),
Tanjung Offshore Services Sdn Bhd
No. 8-3 Jalan Puncak Setiwangsa 4,
Taman Setiawangsa,
54200 Kuala Lumpur.
Tel : 603 – 4252 3888
Fax : 603 – 4252 1088

Rev	Date	Subject	Prepared by (TOS-MCIM)	Reviewed by (TOS-MCIM)	Approved by
0	06/03/09	Submitted for Review & Approval	HA	MR	
1	17/03/09	Submitted for Review & Approval	HA	MR	

RECORD OF AMENDMENTS

Rev	Details	Revised	Checked	Date
1	• Change Bresle Method process: No Chloride at substrate before blast. • Add options for Media's Chloride measurement: Conductivity meter method	Hafiz Aziz	Mazrin Ramli	17/03/09

1.0 INTRODUCTION

This document outlines the inspection procedure and method to measure the soluble contaminants on blasted surface using Sponge Jet Abrasive Blasting System, which accordance to classification of ISO 8502-6, the Bresle method. This inspection procedure also includes the method to determine the chloride concentration for new and/or recycle Sponge Jet Media that use for surface preparation works.

2.0 OBJECTIVES

The objectives of this procedure are to measure the concentration of soluble contaminants, such as chloride, sulphate, etc on the blasted surface using Sponge Jet Media and also the Media itself after several recycles. The result shall shows the capability of Sponge Jet Media to remove soluble contaminant on corroded surface, the ability to constraint the removed soluble contaminant in the media matrix-itself and the recycle magnitude for Sponge Jet Media to absorb he chloride contaminant until to a point of saturation, where the media can't absorb or remove the soluble contaminant from the corroded surfaces anymore.

3.0 SCOPE

This manual covers the method to measure the soluble contaminant on surface using Bresle Method which accordance to ISO 8502-6 standard. Any equipment that able to conduct the method as per standard is allowed. For measurement of chloride contamination in Sponge Media, the method is per ISO 8502-9, which utilize Chlor*Test Kitawaga Tube or conductivity meter.

4.0 SAFETY PRECAUTION / SAFETY AWARENESS

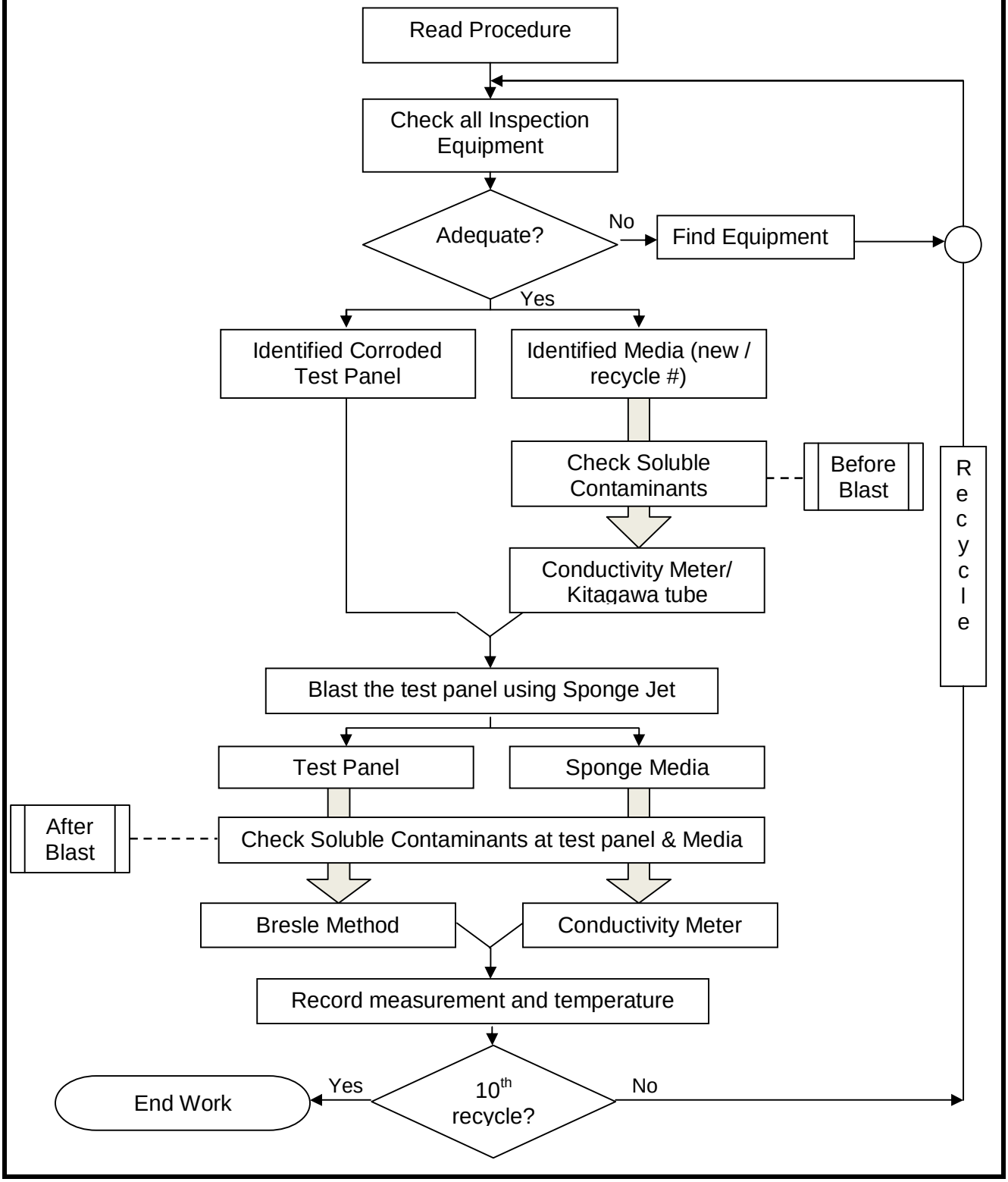
i). Blasting activity is incurred during the inspection, it is advice to wear a face visor, ear plugs and face musk to avoid inhalation of sponge media during the activity.

ii). Avoid any potential of the deionised water and the Sponge Media mix/accidently consume by any personnel. This would cause health constraint.

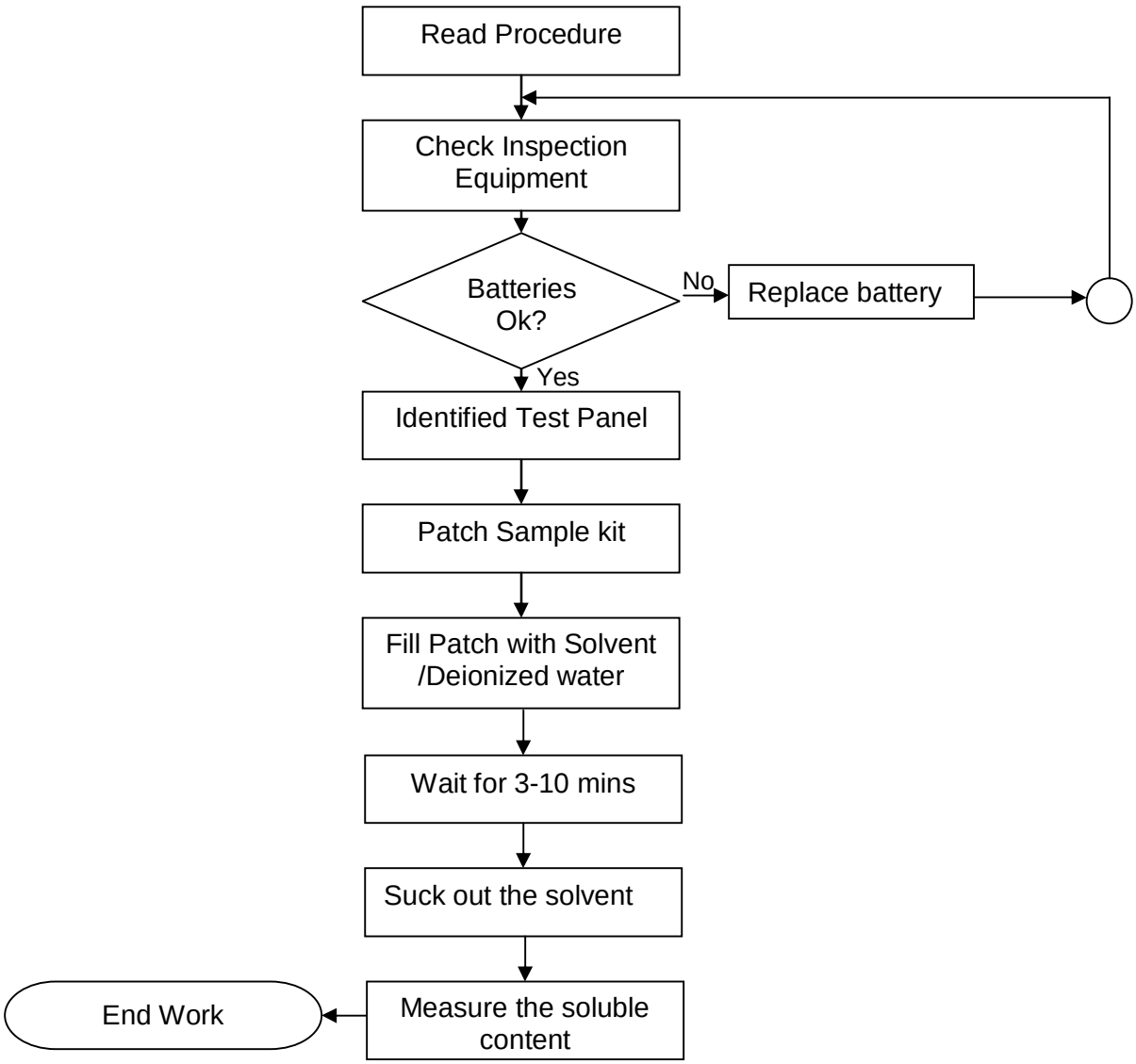
iii). Make sure all blaster is well certified by authorized organization. The inspector for the method written in this document also must be certified by respective organization and well aware about the inspection equipment hazards.

iv). Make sure all air driven equipment (compressor, aftercooler, etc) is inspected by certified inspector.

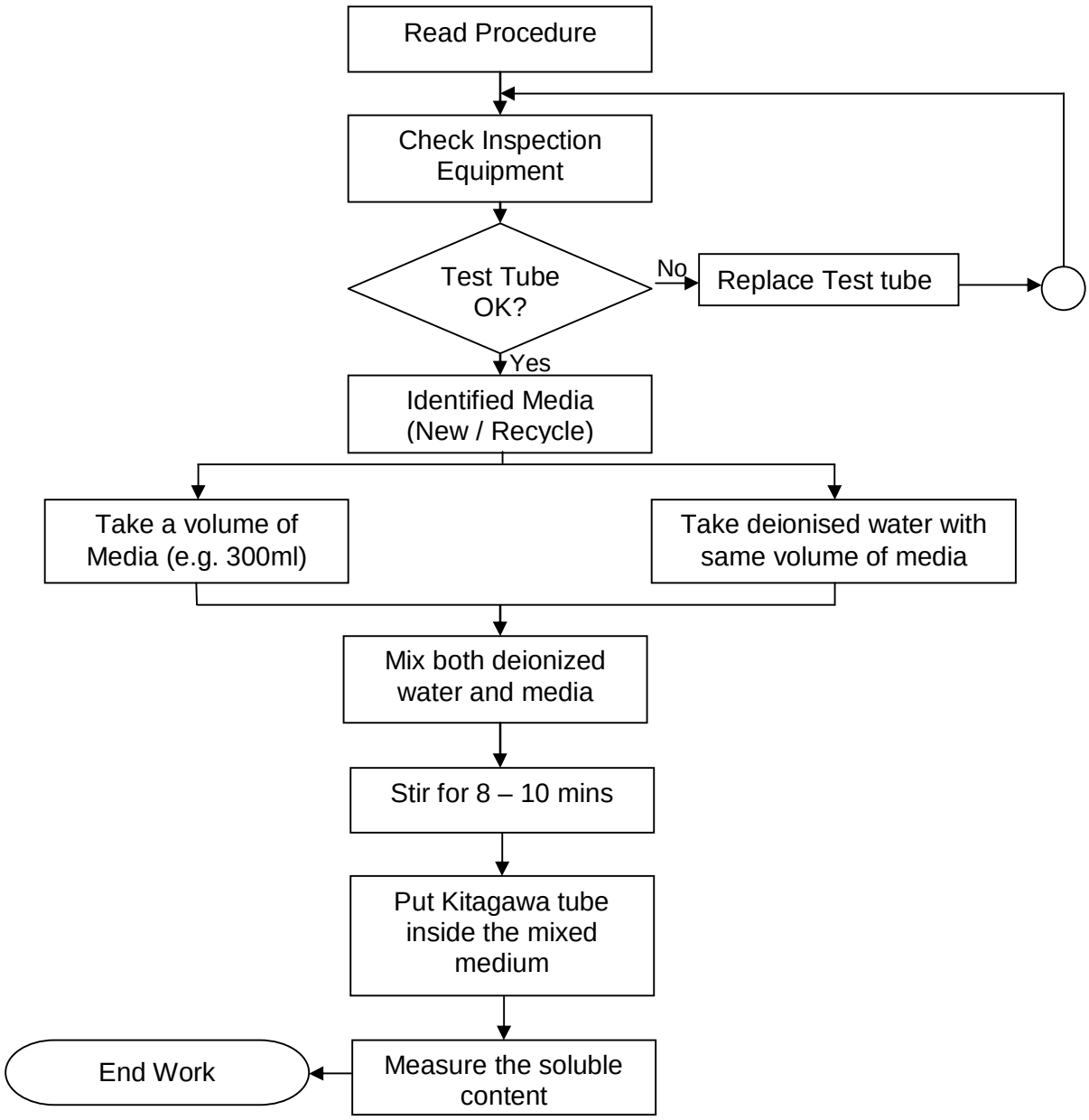
5.1.1 OVERALL INSPECTION PROCEDURE OUTLINE



5.1.2 OPERATION OUTLINE FOR BRESLE METHOD



5.1.3 OPERATION OUTLINE FOR KITAGAWA TUBE TEST



5.2 OPERATION SEQUENCE

5.2.1 OVERALL INSPECTION PROCEDURE

Sponge Jet Abrasive Blasting System is a new surface preparation method which has a capability for cleaning, profiling and at the same time removes chloride contamination on blasted surface. This inspection procedure is measuring the performance of Sponge Jet media for above mentioned statement and also finding the optimum recycles capacity to perform the surface preparation as per international standard. Below work sequence is the procedure to determine the soluble contaminant at test panel (before and after blast with Sponge Media) and also the chloride content within the media itself (new and recycle).

All blasting equipment is checked prior to execute the inspection procedure. Make sure all connection for hoses is well secure, the compressor is clean, aftercooler is well operated, filter is new and test run is already conducted to check whether the compressor contain any trapped water inside the system. Below are the inspection parameters (constant):

A. Use two begs of Sponge Media
B. Use 400 HP feed unit with connect to compressor at least 375 cfm
C. Every test panel size is at least 1’ x 1’
D. The outlet pressure at nozzle is set between range of 80 – 125 psi
E. Output of media (media feed pressure) is set from range 30 – 40 psi
F. The relative humidity is allowing the blasting activity

Overall Procedures

I. Prepare all testing equipment (Bresle kit, Kitagawa tubes, etc) at site.

II. Then make sure all test panels is ready. This document suggested 10 panels to be tested as to measure the chloride contaminant within the recycled sponge media up to 10 times. Add test panel if need more data collection.

III. Please take note the type of sponge media for the test. (Silver #16 / Silver #30 / Silver #80 / etc)

IV. Check soluble contaminant at both test panel by Bresle method and Sponge media using Kitagawa tube prior blasting. Record the measurement

V. Blast the test panel using Sponge Jet Abrasive Blasting System. Keep blasting the media until all the media is blown out from the feed unit even the panel is already achieve Surface Cleanliness 2.5 and profile 75 microns. Check with necessary gauge for cleanliness and profile.

VI. Collect back all media with proper tools (e.g. vacuum, broom, etc).

VII. Once the media is collected, do the soluble contaminant inspection at both test panel and media as per procedure no IV.

VIII. Record all after blast data and also the temperature during the inspection was done.

IX. Repeat above procedure using same Sponge Media BUT difference panel (means new panel every cycle) until 10 times.

Bresle Method Procedure *(please refer to attachment for detail procedure)*

I. Check the inspection equipment is ok. Replace battery if necessary.

II. Identified the test panel to be tested (before blast, after blast, etc)

III. Patch the kit at test panel and make sure no leakages.

IV. Fill in deionised water inside the patch using syringe provided with the kit

V. Wait about 3 – 10 minutes to allow the deionised water to dissolve all soluble contaminants at the patches

VI. Suck back the solvent with syringe and measure the soluble contaminants using the measuring equipment provided with the kit

VII. Record the data

Procedure for Kitagawa Tube

I. Identified the Sponge Media to be tested (new / recycle / etc)
II. Prepare a beaker, stirrer and new Kitagawa tube at site.
III. Take a volume of the identified media, about 100 – 300 ml, a put into the beaker. The volume is depending of the beaker size and shape.
IV. Measure deionised water with the same volume of the measured Sponge Media
V. Mix both Media and Deionised water and stir for about 8-10 minutes.
VI. Take Kitagawa tube at break at both ends using necessary equipment
VII. Put the tube inside the mixer for 1 – 5 minutes to allow the tube to wicked up the solution (capillary action).
VIII. The tube will measure the chloride content by changing colour to oblique when it fully saturate. The measurement of the chloride content can be read at the level of the colour. The measurement is ppm
IX. Record the data

Procedure for Conductivity Meter

I. Depending on conductivity meter being used to inspect, the chloride measurement is shows on the reading from the meter and the tabulate table that's come with the meter.
II. The specimen is prepared by taking a volume of media and mix it with the ionised water with also has the same volume of media.
III. Stir the mixing for about 5 10 minutes using clean stirrer.
IV. Then dip the conductivity meter probe inside the mixing to measure the soluble contaminant.
V. Record the data

Attachment