

# Schedule

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Singapore 637454

Certificate No. : LA-2013-0536-G

Issue No. : 4

Date : 26 May 2017

Page : 1 of 8

FIELD OF TESTING : Mechanical Testing

PRODUCTS TESTED	TESTS/PROPERTIES	STANDARD METHODS/ TECHNIQUES
<p><b>A. Metals, Metal Products and Welds</b></p>	<p><b>1. Tension Tests</b> a) Tension test on structural steel plate, sheet, tubular product</p>	<p>ASTM A370-2017 ASTM E8/E8M-2013a BS EN ISO 6892-1-2009 ASTM A20/A20M-2013 ASTM A36/A36M-2012 ASTM A516/A516M-2010 ASTM A615/A615M-2016 ASTM A962/A962M-2016b ASTM B557-2015 API 5L-2012 45<sup>th</sup> Edition API 2H 2006 (R2012) API 2W 2006 (R2012) API 1104-2013 21<sup>st</sup> Edition Errata1,2,3 and addendum 2014 AWS D1.1/D1.1M-2015 AWS D1.2/D1.2M-2014 ASME IX-2015 AS 1391-2007 BS EN 10002-1: 2001 BS EN 10025-1: 2004 BS EN 10025-6: 2004 BS EN 10225: 2009 BS EN ISO 15614-1: 2004 + A2: 2012 BS EN ISO 4136: 2012 DNV rules for classification of ships-Jan 2013 DNV offshore standards B101-Oct 2012 DNV offshore standards F101-Oct 2013 Appendix B, B300 ISO 5178: 2011 ISO 2566-1: 2001</p>

# Schedule



Certificate No. : LA-2013-0536-G

Issue No. : 4

Date : 26 May 2017

Page : 2 of 8

PRODUCTS TESTED	TESTS/PROPERTIES	STANDARD METHODS/ TECHNIQUES
	b) Through-thickness tensile test	ASTM A370-2017 ASTM A770/A770M-2003 (R2012) API 2W-2006 (R2012) API 2H-2006 (R2012) ISO 7778: 2014 BS EN 10164: 2004 BS EN ISO 11960: 2014
	c) All weld tensile test	ASTM A370-2017 AWS D1.1 / D1.1M-2015 AWS D1.2/D1.2M-2014 *BS EN ISO 15614-1: 2004 + A2: 2012
	d) Elevated temperature tension tests of metallic materials	ASTM E21: 2009
	<b>2. Impact Tests</b> Charpy V-notch impact test <i>Temperature From ambient down to -196 °C</i>	ASTM A370-2017 ASTM E23-2012c ASTM A962/A962M-2016b AWS D1.1/D1.1M-2015 API 5L-2012 45 <sup>th</sup> Edition BS EN 10025-1: 2004 BS EN 10025-2: 2004 BS EN ISO 148-1: 2010 BS EN ISO 15614-1: 2004 + A2: 2012 BS EN ISO 11960: 2014 ISO148-1: 2009 2 <sup>nd</sup> Edition DNV offshore standards F101- Oct 2013 Appendix B, B400
	<b>3. Flattening Tests</b>	ASTM A370-2017
	<b>4. Flaring / Flanging Tests</b>	ASTM A370-2017

# Schedule



Certificate No. : LA-2013-0536-G

Issue No. : 4

Date : 26 May 2017

Page : 3 of 8

PRODUCTS TESTED	TESTS/PROPERTIES	STANDARD METHODS/ TECHNIQUES
	<b>5. Bend Tests</b> 3-point Bend Test	ASTM A370-2017 ASTM E190-2014 ASTM E290-2014 ASTM A962/A962M-2016b ASTM E855-2008(R2013) ASTM A615/A615M-2016 AWS D1.1/D1.1M-2015 ASME IX-2015 BS EN ISO 5173: 2010 + A1: 2011 BS EN ISO 15614-1: 2004 + A2: 2012 BS EN ISO 11960: 2014 BS EN ISO 7438: 2005 DNV offshore standards F101-Oct 2013 Appendix B B500 API 1104-2013 21 <sup>st</sup> Edition Errata1,2,3 and addendum 2014
	<b>6. Fracture Tests</b> Fracture Test	AWS D1.1/D1.1M-2015 AWS D1.2/D1.2M-2014 ASME IX-2015
	<b>7. Nick Break Test</b> Nick break Test	API 1104-2013 21 <sup>st</sup> Edition Errata1,2,3 and addendum 2014
	<b>8. Hardness Tests:</b> a) Micro and macro vickers hardness	ASTM E384-2016 ASTM E92-2016 ISO 6507-1:2005 ASTM A370-2017 ASTM A962/A962M-2016b BS EN ISO 6507-1: 2005 BS EN ISO 9015-1: 2011 DNV offshore standards F101-Oct-2013 Appendix B - B1000 /B1003 / B1011 NACE MR0175 / ISO 15156-2: 2009 NACE MR0175 / ISO 15156-3: 2009

# Schedule



Certificate No. : LA-2013-0536-G

Issue No. : 4

Date : 26 May 2017

Page : 4 of 8

PRODUCTS TESTED	TESTS/PROPERTIES	STANDARD METHODS/ TECHNIQUES
	b) Rockwell hardness	ASTM E18-2016 ISO 6508-1: 2005 ASTM A370-2017 ASTM A962/A962M-2016b BS EN ISO 6508-1: 2005 NACE MR0175 / ISO 15156-2: 2009 NACE MR0175 / ISO 15156-3: 2009 DNV offshore standards F101-Oct- 2013 Appendix B, B1011
	c) Brinell hardness	ASTM E10-2015a ISO 6506-1: 2005 BS EN ISO 6506-1: 2005 ASTM A370-2017 ASTM A962/A962M-2016b DNV Offshore Standards F101-Oct-2013 Appendix B, B1011
	<b>9. Metallography:</b>	
	a) Macro-etching of metals & alloys	ASTM E340-2015 ASME IX-2015 AWS D1.1/D1.1M-2015 DNV offshore standards F101-Oct-2013 Appendix B, B1001
	b) Macroscopic examination	ASTM E381-2001 (R2012) ASME IX-2015 AWS D1.1/D1.1M-2015 BS EN 1321: 1997 Amd 2004 DNV offshore standards F101-Oct-2013 Appendix B, B1001
	c) Micro-etching of Metals & Alloys	ASTM E407-2007(2015)e1 DNV offshore standards F101-Oct-2013 Appendix B, B1002
	d) Microscopic Examination	ASTM E562-2011 ASTM E45-2013 BS EN 1321: 1997 Amd 2004 DNV offshore standards F101-Oct-2013 Appendix B, B1002

# Schedule



Certificate No. : LA-2013-0536-G

Issue No. : 4

Date : 26 May 2017

Page : 5 of 8

PRODUCTS TESTED	TESTS/PROPERTIES	STANDARD METHODS/ TECHNIQUES
	e) Sample Preparation	ASTM E3-2011
	f) Determination of average grain size	ASTM E112-2013
	<b>1) Corrosion Testing</b>	
	a) Pitting corrosion	ASTM G48-2011 Method A ASTM A 923 Practice C DNV offshore standards F101-Oct-2013 Appendix B, C200
	b) Inter-granular corrosion	ASTM A262-2015 Practice A ASTM A262-2015 Practice B ASTM A262-2015 Practice E
	c) Detecting susceptibility to intergranular corrosion ( <i>Sulfate-sulfuric acid test</i> )	ASTM G28-2002 (R2015) Method A
	d) Hydrogen-induced Cracking ( <i>HIC Test</i> )	NACE TM0284-2016 DNV offshore standards F101-Oct-2013 Appendix B, C300
	e) Sulfide stress cracking ( <i>SSC Test</i> )	NACE TM0177-2016 ASTM G39-99 (R2011), EFC 16 BS EN ISO 7539-2: 1995 DNV offshore standards F101-Oct-2013 Appendix B, C400
	<b>1) Fracture Toughness Tests</b>	
	a) Single edge notch bend / Single edge notch tension ( <i>SENB / SENT</i> )	BS 7448 Part 1: 1991 (2002) BS 7448 Part 2: 1997 BS EN ISO 15653: 2010 API 2Z-2005 4 <sup>th</sup> Edition API 1104-2013 21 <sup>st</sup> Edition ASTM E1820 – 2015a e1 ISO 12135: 2002 DNV offshore standards F101-Oct-2013 Appendix B, B800 DNV– RP-F108 Jan 2006 BS 8571-2014

# Schedule



Certificate No. : LA-2013-0536-G

Issue No. : 4

Date : 26 May 2017

Page : 6 of 8

PRODUCTS TESTED	TESTS/PROPERTIES	STANDARD METHODS/ TECHNIQUES
	<b>1: Coating Evaluation</b> a) Cathodic Disbondment Test  b) Hot water soak  c) Non-destructive measurement of film thickness of pipeline coating on steel  d) Impact resistance (Falling weight test)  e) Penetration resistance of pipeline coatings ( <i>Blunt rod</i> )  f) Holiday detection  g) Pull-off test for adhesion  h) Adhesion or cohesion strength of thermal spray coatings  i) Hardness test ( <i>Shore D</i> )  j) Coating Tensile & elongation test	AFNOR NF A49-711 (1992) Annex K AFNOR NF A49-716 (1998), Annex E NACE SP0394-2013 CAN / CSA-Z245.20-2010 Para 12.8 CAN / CSA-Z245.21-2010 Para 12.3 EN 12068 (1999) Annex K ISO 21809-3 (2016) Annex -G  NACE SP0394-2013 GBE / CW6 Part 1 Appendix E  ASTM G12-2007 (R2013)  ASTM G14-2004 (2010) e1  AFNOR NF A49-711 (1992), Annex D NACE SP0394-2013 EN 12068 (1999) Annex H ISO 21809-3 (2016) Annex D  ASTM G17-2007 (R2013)  ASTM G62-2014  ISO 4624-2002 BS EN ISO 4624-2003 ASTM D 4541: 2009e1  ASTM C633-2013  CAN / CSA-Z245.20-2010 Para 12.14  ISO 868-2003 ASTM D2240-2003  DIN 30670-1991 ISO 527-1: 2012 ISO 527-2: 2012

# Schedule



Certificate No. : LA-2013-0536-G

Issue No. : 4

Date : 26 May 2017

Page : 7 of 8

PRODUCTS TESTED	TESTS/PROPERTIES	STANDARD METHODS/ TECHNIQUES
	k) Coating flexibility test	CAN / CSA-Z245.20-2010 Para 12.11
	l) Determination of gel time	CAN / CSA-Z245.20-2010 Para 12.2 NACE SP0394-2013
	m) Coating adhesion test	CAN / CSA-Z245.20-2010 Para 12.14
	n) Coating interface contamination test	CAN / CSA-Z245.20-2010 Para 12.9
	o) Coating cross section or interface porosity test	CAN / CSA-Z245.20-2010 Para 12.10
	p) Moisture content test	CAN / CSA-Z245.20-2010 Para 12.4
	q) Coating peel strength test	CAN / CSA-Z245.21-2010 Para 12.4 DIN EN 10329:2006 Annex D EN 12068 (1999) Annex C
	r) Coating indentation test	AFNOR NF 49-711 (1992), Annex F DIN 30670-1991 EN 12068 (1999) Annex G
	s) Coating peel strength test	AFNOR NF 49-711 (1992), Annex E AFNOR NF A49-716 (1998), Annex K ISO 21809-3 (2016) Annex H
	t) Determination of flexural properties	ISO 178: 2010
	u) Bend Test	AFNOR NF A49-711: 1992, clause 9.16
	v) Test Method for Tear Strength	ASTM D624-2000
	w) Determination of Abrasion Resistance	DIN 53516-1987 / ISO 4649-2010

\* Indicates Product Specification

# Schedule



Certificate No. : LA-2013-0536-G

Issue No. : 4

Date : 26 May 2017

Page : 8 of 8

## Approved Signatories

Dr Asim Bag – All tests

Mr Tusar Kanti Roy – All tests

## Note :

This laboratory is accredited in accordance with the recognised International Standard ISO/IEC 17025. A laboratory's fulfilment of the requirements of ISO/IEC 17025 means the laboratory meets both the technical competence requirements and **management system requirements** that are necessary for it to consistently deliver technically valid test results. The **management system requirements** in ISO/IEC 17025 are written in language relevant to laboratory operations and operate generally in accordance with the principles of ISO 9001.