

Schedule

Element Materials Technology Singapore Pte Ltd
West Point Bizhub
106 Tuas South Avenue 2
Singapore 637158

Certificate No. : LA-2018-0689-G

Issue No. : 5

Date : 24 August 2022

FIELD OF TESTING : Mechanical Testing

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MATERIALS / PRODUCTS TESTED	TESTS / PROPERTIES	STANDARD METHODS / TECHNIQUES / EQUIPMENT
<p>A Metals, Metal Products & Welds</p>	<p><u>Mechanical Tests</u></p> <p>1. Tension Test on Structural Steel Plate, Sheet Tubular Machine Capacity up to 1000 kN</p>	<ul style="list-style-type: none"> • ASTM A370-21 • ASTM B557-15 • ASTM B557M-15 • ASTM E8/E8M-21 • *ASTM A20/A20M-20 • *ASTM A36/A36M-19 • *ASTM A516/A516M-17 • *ASTM A615/A615M-20 • *ASTM A962/A962M-19 • API 5L: 2018 46th Ed Errata 1: 2018 • API 2H:2006(R2020), 9th Ed • *API 2W: 2019 6th Ed • API 1104:2021, 22nd Edition • AWS D1.1/D1.1M:2020 • AWS D1.2/D1.2M:2014 Errata 2014 • AWS D1.6/D1.6M:2017 • ASME BPVC IX-2021 • AS 1391:2020 • BS EN 10025-1:2004 • BS EN 10025-6:2019 • BS EN ISO 6892-1:2019 • BS EN ISO 4136:2012 • *BS EN 10225-1:2019 • *BS EN 10225-2:2019 • *BS EN 10225-3:2019 • *BS EN 10225-4:2019 • *BS 111:2019 • *BS EN ISO 15614-1:2017+A1:2019 • *DNVGL Rules for Classification of Ships July 2021 • *DNVGL-OS-B101 July 2020 “Metallic Materials” • *DNVGL-ST-F101 2017 Appendix B, B300 • ISO 4136:2012 • ISO 5178:2019 • ISO 6892-1:2019 • *ISO 2566-1:2021 • *ABS Rules Part 2 2022

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A Metals, Metal Products & Welds	2. Tension Test at Elevated Temperature (150°C)	<ul style="list-style-type: none"> • ASTM E21-20
	3. Tension and Proof Load Test on Fastener	<ul style="list-style-type: none"> • ASTM F606/F606M-21 • *ASTM A194/A194M-20a • *ASTM A193/A193M-20 • *ASTM A962/A962M-19 • ISO 898-1:2013 • ISO 898-2:2012
	4. Through-Thickness Tensile Test	<ul style="list-style-type: none"> • ISO 7778:2014 • *ASTM A770/A770M-03(2018) • *API 2W:2019 6th Ed • *API 2H:2006(R2020), 9th Ed • *BS EN 10164:2018
	5. All Weld Tensile Test	<ul style="list-style-type: none"> • AWS D1.1/D1.1M:2020 • AWS D1.2/D1.2M:2014 Errata 2014 • *BS EN ISO 15614-1:2017+A1:2019 • * DNVGL-ST-F101 2017
	6. Charpy V-notch Impact Test Temperature From Ambient Temperature Down to -196°C	<ul style="list-style-type: none"> • ASTM A370-21 • ASTM E23-18 • AWS D1.1/D1.1M:2020 • API 5L: 2018 46th Ed Errata 1:2018 • BS EN 10025-1:2004 • BS EN 10025-2:2019 • BS EN ISO 148-1:2016 • *BS EN ISO 15614-1:2017+A1:2019 • *BS EN ISO 11960:2021 • ISO 148-1:2016 • *ASTM A962/A962M-19 • * DNVGL-ST-F101 2017 Appendix B, B400
	7. Flattening Test	<ul style="list-style-type: none"> • ASTM A370-21 • *ASTM A106/106M-19a • *ASTM A530/A530M-18 • *ASTM A1016/A1016M-18a
	8. Flaring / Flanging Test	<ul style="list-style-type: none"> • ASTM A370-21 • *ASTM A1016/A1016M-18a

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A Metals, Metal Products & Welds	9. 3-Point Bend Test	<ul style="list-style-type: none"> • ASTM A370-21 • *ASTM A615/A615M-20 • *ASTM A962/A962M-19 • ASTM E855/E855M-21 • ASTM E190-21 • ASTM E290-14 • AWS D1.1/D1.1M:2020 • ASME BPVC IX-2021 • ISO 5173: 2009 + A1:2011 • BS EN ISO 5173: 2010+A1:2011 • BS EN ISO 7438:2020 • *BS EN ISO 15614-1:2017+A1:2019 • *BS EN ISO 11960:2021 • AWS D1.6/D1.6M:2017 • AWS D1.2/D1.2M:2014 Errata 2014 • API 5CT:2018, 10th Ed + Addendum 1 (2021) • * DNVGL-ST-F101 2017 Appendix B500 • API 1104:2021, 22nd Edition • *ABS Rules Part 2 2022
	10. Fracture Test	<ul style="list-style-type: none"> • AWS D1.1/D1.1M:2020 • AWS D1.2/D1.2M:2014 Errata 2014 • AWS D1.6/D1.6M:2017 • ASME BPVC IX-2021 • BS EN ISO 9017:2018 • *ABS Rules Part 2 2022
	11. Fracture Toughness: Single Edge Notch Bend (SENB)	<ul style="list-style-type: none"> • BS 7448-1:1991 • BS 7448-2:1997 • BS EN ISO 15653:2018 • API RP 2Z: 2005 4th Ed Reapproved 2020 • • API 1104:2021, 22nd Edition • * DNVGL-ST-F101 2017 Appendix B, B800 • ISO 12135:2021 • ASTM E1820-21
	12. Fracture Toughness: Single Edge Notch Tension (SENT)	<ul style="list-style-type: none"> • DNVGL RP-F108-2019
	13. Nick-Break Test	<ul style="list-style-type: none"> • • API 1104:2021, 22nd Edition
14. Fatigue Testing of Reinforcing Bar	<ul style="list-style-type: none"> • BS 4449:2005+A3:2016 	

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A Metals, Metal Products & Welds	15. Shear Strength	<ul style="list-style-type: none"> • ASTM A264-12(2019) • ASTM A265-12(2019)
	16. <u>Metallography</u> Vickers Hardness Test	<ul style="list-style-type: none"> • ASTM A370-21 • *ASTM A962/A962M-19 • ASTM E92-17 • BS EN ISO 6507-1:2018 • * DNVGL-ST-F101 2017 Appendix B, B1003 • * DNVGL-ST-F101 2017 Appendix B, B1011
	17. Rockwell Hardness Test	<ul style="list-style-type: none"> • BS EN ISO 6508-1:2016 • ASTM E18-20 • ASTM A370-21 • * DNVGL-ST-F101 2017 Appendix B, B1011 • *ASTM A962/A962M-19
	18. Brinell Hardness Test	<ul style="list-style-type: none"> • BS EN ISO 6506-1:2014 • ASTM E10-18 • ASTM A370-21 • * DNVGL-ST-F101 2017 Appendix B, B1011 • *ASTM A962/A962M-19
	19. Microindentation Hardness Test	<ul style="list-style-type: none"> • ASTM E384-17
	20. Macroetching of Metals & Alloys	<ul style="list-style-type: none"> • ASTM E340-15 • ASME BPVC IX-2021 • AWS D1.1/D1.1M:2020 • * DNVGL-ST-F101 2017 Appendix B, B1001 • ASTM E381:2020 • ASTM A604/A604M-07(2022)
	21. Macroscopic Examination	<ul style="list-style-type: none"> • ASME BPVC IX-2021 • AWS D1.1/D1.1M:2020 • AWS D1.2/D1.2M:2014 Errata 2014 • AWS D1.6/D1.6M:2017 • * DNVGL-ST-F101 2017 Appendix B, B1001 • BS EN ISO 17639:2022 • ISO 5817:2014 • *ABS Rules Part 2 2022

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A Metals, Metal Products & Welds	22. Microetching of Metals & Alloys	<ul style="list-style-type: none">• ASTM E407-07(2015)e1• * DNVGL-ST-F101 2017 Appendix B, B1002
	23. Microscopic Examination	<ul style="list-style-type: none">• ASTM E562-19e1• ASTM E45-18a• BS EN 1321:1997• BS EN ISO 17639:2022• * DNVGL-ST-F101 2017 Appendix B, B1002
	24. Sample Preparation	<ul style="list-style-type: none">• ASTM E3-11(2017)
	25. Determination of Average Grain Size	<ul style="list-style-type: none">• ASTM E112-13(2021)
	<u>Corrosion Tests</u>	
	26. Corrosion Testing	<ul style="list-style-type: none">• ASTM G48-11(2020)e1, Practice A• ASTM G48-11(2020)e1, Practice C• ASTM G48-11(2020)e1, Practice E• ASTM A923:2014 Method C
	27. Pitting Corrosion	<ul style="list-style-type: none">• * DNVGL-ST-F101 2017 Appendix B, C200
	28. Intergranular Corrosion	<ul style="list-style-type: none">• ASTM A262-15(2021), Practice A• ASTM A262-15(2021), Practice B• ASTM A262-15(2021), Practice C• ASTM A262-15(2021), Practice E• ASTM A262-15(2021), Practice F
	29. Hydrogen Induced Cracking (HIC)	<ul style="list-style-type: none">• NACE TM0284-2016• * DNVGL-ST-F101 2017 Appendix B, C300
	30. Sulfide Stress Cracking (SSC)	<ul style="list-style-type: none">• NACE TM0177-2016• NACE TM0316-2016• ASTM G39-99(2021)• EFC No 16 3rd Edition• * DNVGL-ST-F101 2017 Appendix B, C400

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A Metals, Metal Products & Welds	31. Detecting Susceptibility to Intergranular Corrosion (Ferric Sulfate – Sulfuric Acid Test)	• ASTM G28-02(2015) Method A
	<u>Coatings</u>	
	32. Cathodic Disbondment	• AFNOR NF A49-711 (1992), Annex K • AFNOR NF EN 10329 (A49-716) Annex E (2006) • NACE SP0394-2013, Appendix F • CSA Z245.20-14 Section 12.8 Update No. 3, May 2016 • ISO 21809-1:2018, Annex H • ISO 21809-3:2016 Amd.1:2020, Annex G • ASTM G8-96(2019) • ASTM G42-11(2019)e1
	33. Hot-Water Soak	• NACE SP0394-2013, Appendix J • ISO 21809-3:2016 Amd.1:2020, Annex I
	34. Nondestructive Measurement of Film Thickness of Pipeline Coatings on Steel	• ASTM D7091-21 • ISO 21809-1:2018, Annex A • ISO 21809-3:2016 Amd.1:2020, Annex B
	35. Penetration Resistance of Pipeline Coatings (Blunt Rod)	• ISO 21809-3:2016 Amd.1:2020, Annex E (excluding pressure of 0.10 N/mm ²)
	36. Holiday Detection	• ASTM G62-14 • ISO 21809-1:2018, Annex B • ISO 21809-3:2016 Amd.1:2020, Annex C
	37. Pull-off Test for Adhesion	• ISO 4624:2016 • BS EN ISO 4624:2016
	38. Adhesion or Cohesion Strength of Thermal Spray Coatings	• CSA Z245.20-14 Section 12.14 Update No. 3, May 2016
	39. Peel Strength Test	• ISO 21809-1:2018, Annex C • ISO 21809-3:2016 Amd.1:2020, Annex H
40. Impact Test	• ISO 21809-3:2016 Amd.1:2020, Annex D	

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* Product Specification

Approved Signatories

S/N	Name	Scope
1.	Mr Aldrin C. Quijada	- For all accredited tests.
2.	Mr Rory L. Dapitan	- For all accredited tests.
3.	Mr Ramesh Sellapan	- For all accredited tests except tests 20 to 25 and 32 to 40.
4.	Ms Khin Ohnmar Aung	- For accredited tests 32 to 40 only (i.e. coating tests).
5.	Dr Basab Bhattacharya	- For all accredited tests.
6.	Mr Kingsley Leong	- For accredited test no. 1, 3-10, 13, 16-22 & 24-25 only

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.