



ONE EIGHTY MATERIALS ENGINEERING SOLUTIONS (PTY) LTD - TEST REPORT

Report Information		Company Information
Report Number	R-RE09-04-01	Director JA Cotton BSc (Eng) PhD (Mat Eng UCT), PrEng Postal: Postnet Suite 78, Private Bag X11 Mowbray 7705, Cape Town Physical: Building 13, The Waverley Business Park, Wyecroft Rd, Mowbray 7925, Cape Town. Tel: +27 21 447 5258/4643 Fax: +27 86 617 1047 www.one-eighty-degrees.com Reg No 2007/007050/07 VAT No 4410261889 OE-MSP-02 SF28 Rev 21 Disclaimer Test results only relate to items tested. Test results apply to the sample as received. Samples will be kept for 1 month from this report date unless otherwise requested. Opinions and interpretations expressed herein are outside the scope of SANAS accreditation.
Revision	00	
Report Author	Marcelle de Waal	
TFE Number	T-RE09-04-02 (MDW-M)	
Customer PO Number:	C.O.D.	
Technical Signatory	Sarah Virgin 	
Witnessed By	N/A	
Tested By	Sibusiso Masondo	
Customer Name	Altius Trading 383 (Pty) Ltd t/a Rebul Crating Solutions	
Customer Contact Details	+27 21 552 1079	
Customer Address	96 Bofors Circle, Epping 2, Cape Town, 7460	
Date of Issue of the Report	2025/02/06	

1. Introduction

One Eighty Materials Engineering Solutions (Pty) Ltd (OEMES) was appointed by Altius Trading 383 (Pty) Ltd t/a Rebul Crating Solutions to conduct mechanical testing on multiple cardboard-based corrugated and honeycomb panels used in crate/box manufacturing. The objective was to evaluate the flexural and compressive performance of these panels and to benchmark their structural behaviour.

2. Test Methodology

Mechanical testing was conducted on multiple cardboard panel configurations to assess their structural performance under flexural and compressive loading conditions. The following test methods were conducted on the panel samples:

2.1 3-Point Bend Testing was performed on each panel sample to evaluate the flexural performance. Parameters measured included maximum load, deflection at peak load, maximum flexural stress, and flexural modulus of elasticity. Results were reported as minimum, average, and maximum values for each test group.

2.2 Flexural Compression Testing was conducted by axially compressing each specimen along its longitudinal axis to induce buckling. This test aimed to simulate edgewise compressive failure and assess the structural limits of the cardboard panel core designs. Mechanical parameters recorded included the maximum compressive load, compressive strength, apparent modulus of elasticity, and critical buckling load. Results were reported as minimum, average, and maximum values for each test group.

3. Sample Designation

Pre-cut samples were prepared by Rebul and provided for testing, as designated in Table 1 below. Photographic images of the samples are available for review in Appendix 5.1.

Table 1: Sample Designation

Sample	Description	Thickness:
A	10mm LC 125gsm	9mm
B	10mm LC 120gsm	9mm
C	RED4 JC9272	3mm
D	RED24 JC9273	3mm
E	RED32 JC9274	3mm
F	K1 22 202308	3mm
G	K2 GK 276176	3mm
H	K3 A/C 2 279477 HC	3mm
I	K4 530367	3mm
J	K5 C FLUTE 530495	3mm
K	K6 279875 RB	3mm
Received Panel Dimensions: <i>350 x 70 mm variable thicknesses for each group</i>		

4. Results

4.1 3-Point Bending Tests

Results of the 3-point bending tests are presented in Table 2 below. Graphical representation of the test data is illustrated in Figure 1.

Table 2: 3-Point Bending Testing – Summary Results

3-Point Bend Test - Summary Results																
Sample	* Description	Width (b)	Thickness (h)	** Span Length (L)	Max Load (P)			Deflection @ Max Load (d)			Flexural Stress @ Max Load (σ)			Flexural Modulus (E)		
					Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max
Unit	-	mm	mm	mm	kg			mm			MPa			MPa		
A	10 mm LC 125gsm	70	10	150	3.57	3.96	4.35	3.37	3.39	3.42	1.13	1.25	1.37	178.90	216.83	254.76
B	10 mm LC120gsm	70	10	150	1.24	1.30	1.36	2.15	2.23	2.30	0.39	0.41	0.43	99.51	113.69	127.87
C	RED4 JC9272	70	3	150	1.46	1.48	1.50	6.50	6.62	6.75	5.11	5.19	5.27	1238.15	1256.38	1274.61
D	RED24 JC9273	70	3	150	1.53	1.67	1.82	5.04	5.47	5.89	5.36	5.86	6.37	1635.10	1666.69	1698.29
E	RED32 JC9274	70	3	150	1.07	1.36	1.66	4.93	5.46	5.99	3.73	4.78	5.82	1242.97	1418.77	1594.57
F	K1 22 202308	70	3	150	1.71	1.87	2.04	6.25	6.53	6.81	6.00	6.57	7.13	1729.58	1776.31	1823.04
G	K2 GK 276176	70	3	150	1.10	1.12	1.15	7.00	7.58	8.16	3.85	3.94	4.03	853.02	868.95	884.88
H	K3 A/C 2 279477 HC	70	3	150	1.11	1.20	1.29	6.41	7.50	8.59	3.87	4.19	4.51	940.32	964.64	988.96
I	K4 530367	70	3	150	1.13	1.15	1.17	4.72	4.76	4.80	3.95	4.03	4.10	1315.56	1320.38	1325.21
J	K5 C FLUTE 530495	70	3	150	0.42	0.46	0.49	2.03	2.15	2.27	1.47	1.60	1.73	1380.49	1483.70	1586.91
K	K6 279875 RB	70	3	150	0.91	0.94	0.96	4.97	5.49	6.01	3.20	3.28	3.36	932.69	954.06	975.42

Notes: *The designations of the supplied samples were recorded as per inscription provided on samples
 ** A Standardize Span Length of 150mm was utilized for 3-point bend test.

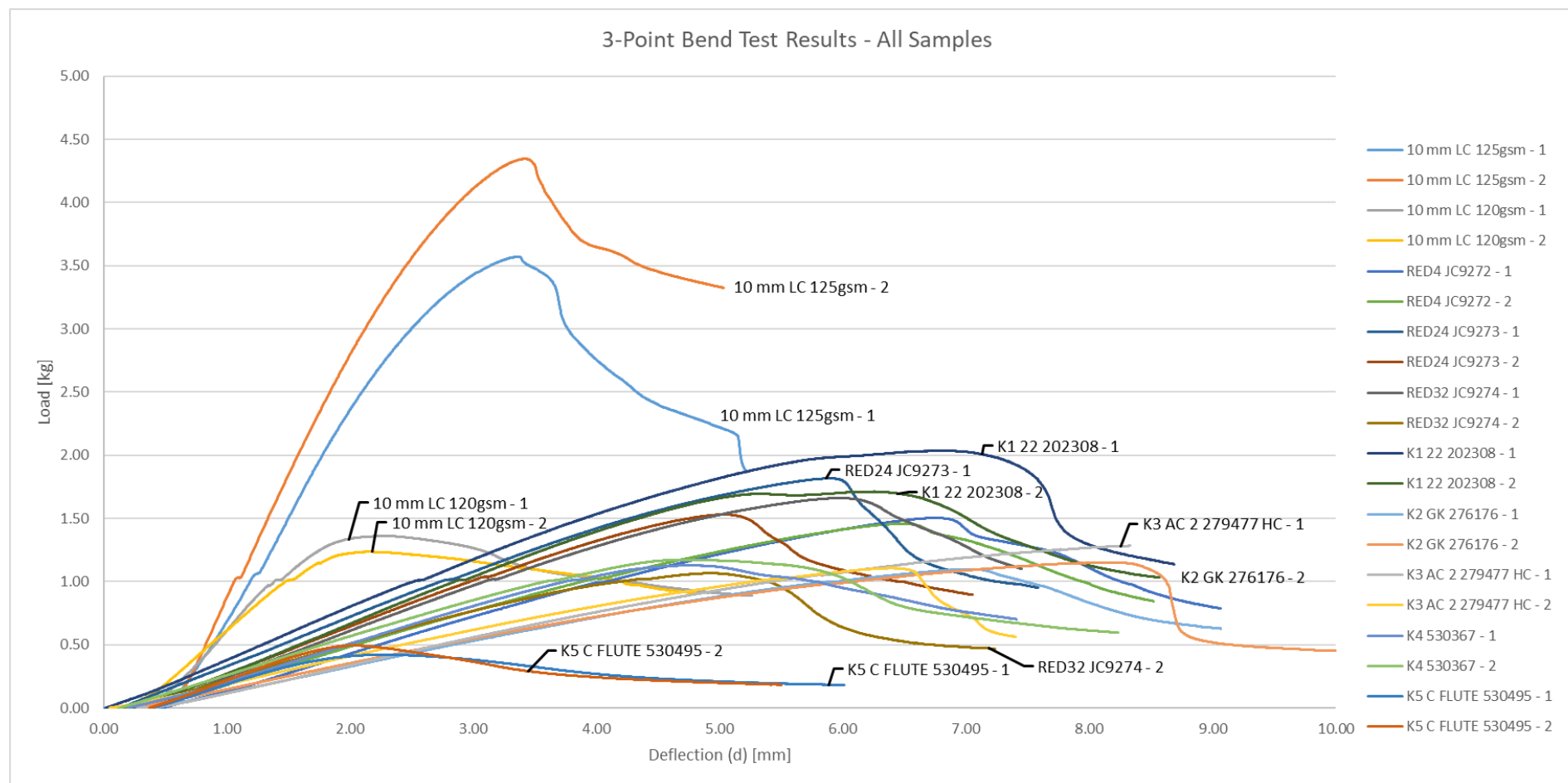


Figure 1: Graphical Representation of 3-Point Bending Results – All Samples

4.2 Flexural Compression Tests

Results of the flexural-buckling compression tests are presented in Table 3. Graphical representation of the test data is illustrated in Figure 2.

Table 3: Flexural-Buckling Compression Testing – Summary Results

Flexural-Buckling Compression Test - Summary Results																					
Sample	* Description	Width (b)	Thickness (h)	Length (L)	Cross-sectional Area	Max Load (P)			Deflection @ Max Load (d)			Compressive Strength (σ)			Apparent Modulus of Elasticity (E_{app})			Critical Buckling Load (P_{cr})			Compression Failure mode
						Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	Min	Avg	Max	
Units	-	mm	mm	mm	mm ²	kg			mm			MPa			MPa			kg			-
A	10 mm LC 125gsm	70	10	350	700	3.57	3.96	4.35	3.36	3.39	3.42	0.05	0.06	0.06	8.24	9.12	10.00	0.395	0.437	0.479	Crushing
B	10 mm LC120gsm	70	10	350	700	1.24	1.30	1.36	2.15	2.23	2.30	0.02	0.02	0.02	4.18	4.74	5.30	0.200	0.227	0.254	Buckling
C	RED4 JC9272	70	3	350	210	1.46	1.48	1.50	6.50	6.63	6.75	0.07	0.07	0.07	4.64	4.71	4.78	0.006	0.006	0.006	Buckling
D	RED24 JC9273	70	3	350	210	1.53	1.60	1.66	5.04	5.51	5.99	0.07	0.07	0.08	5.97	6.04	6.11	0.008	0.008	0.008	Buckling
E	RED32 JC9274	70	3	350	210	1.71	1.87	2.04	6.25	6.53	6.81	0.08	0.09	0.10	6.50	6.64	6.79	0.008	0.009	0.009	Buckling
F	K1 22 202308	70	3	350	210	1.10	1.12	1.15	7.08	7.65	8.21	0.05	0.05	0.05	3.21	3.26	3.32	0.004	0.004	0.004	buckling
G	K2 GK 276176	70	3	350	210	1.11	1.20	1.29	6.41	7.50	8.59	0.05	0.06	0.06	3.55	3.57	3.60	0.005	0.005	0.005	Crushing
H	K3 A/C 2 279477 HC	70	3	350	210	0.49	0.83	1.17	2.03	3.37	4.72	0.02	0.04	0.05	4.93	5.40	5.86	0.006	0.007	0.008	Buckling
I	K4 530367	70	3	350	210	1.28	1.57	1.86	1.50	3.05	4.59	0.06	0.07	0.09	17.20	33.64	50.08	0.022	0.044	0.065	Buckling
J	K5 C FLUTE 530495	70	3	350	210	2.05	2.40	2.75	2.16	5.28	8.41	0.10	0.11	0.13	236.66	314.85	393.03	0.306	0.407	0.508	Crushing
K	K6 279875 RB	70	3	350	210	1.07	1.35	1.63	2.10	2.28	2.47	0.05	0.06	0.08	236.66	314.85	393.03	0.306	0.407	0.508	Buckling

Notes: *The designations of the supplied samples were recorded as per inscription provided on samples

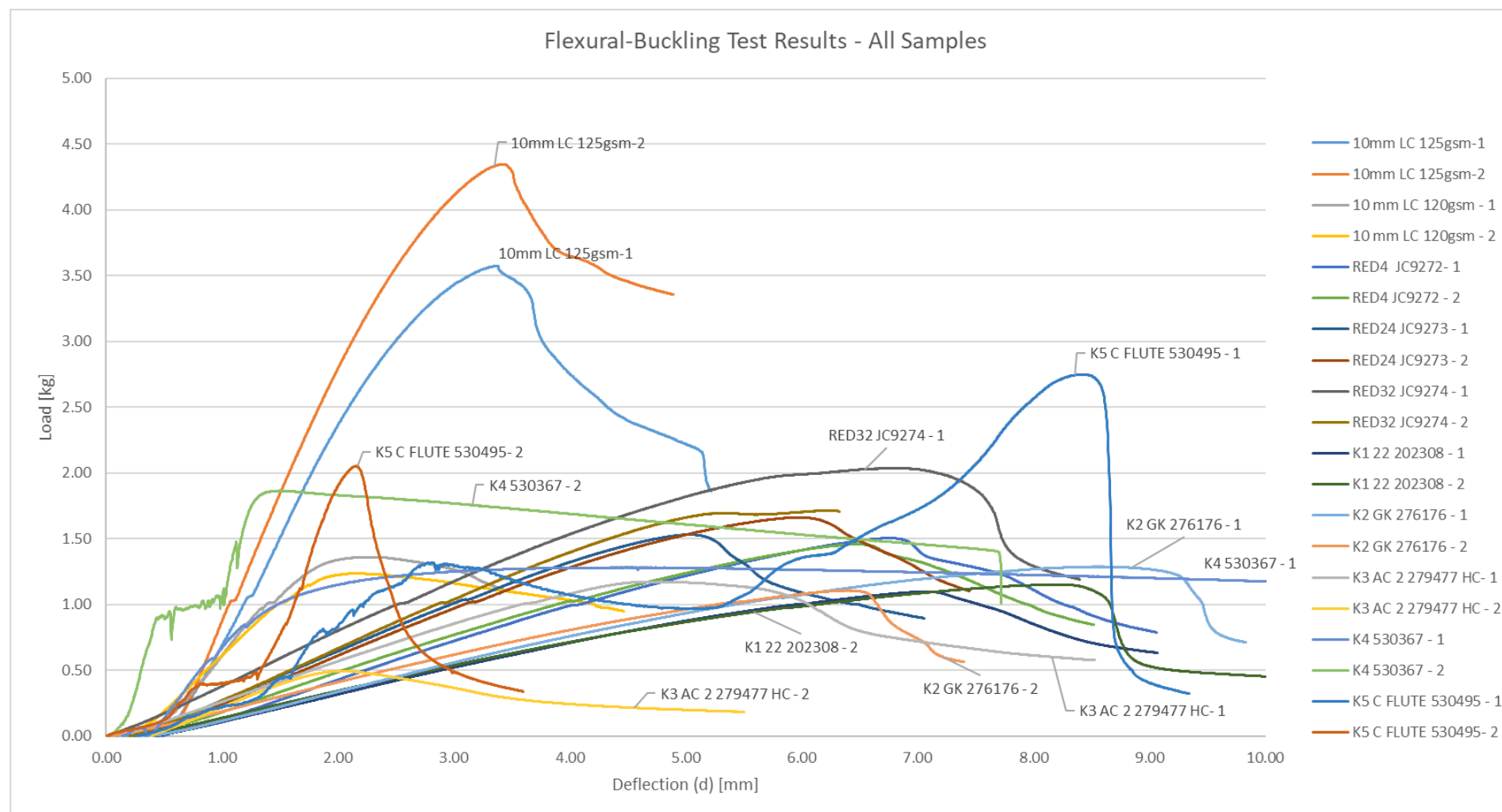
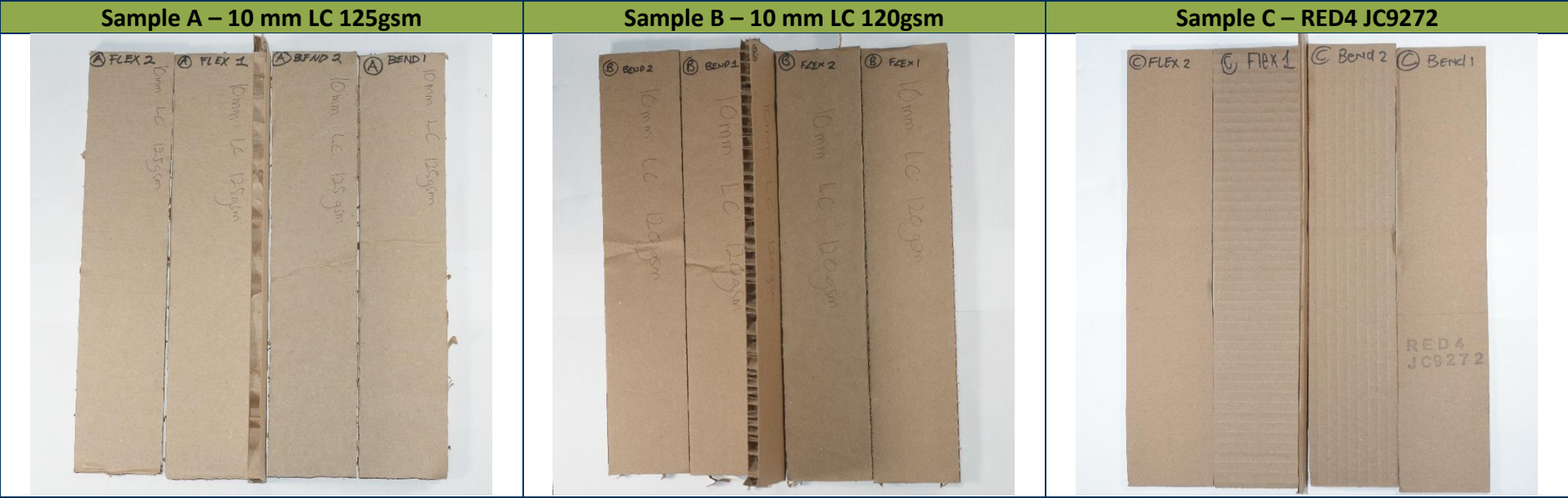
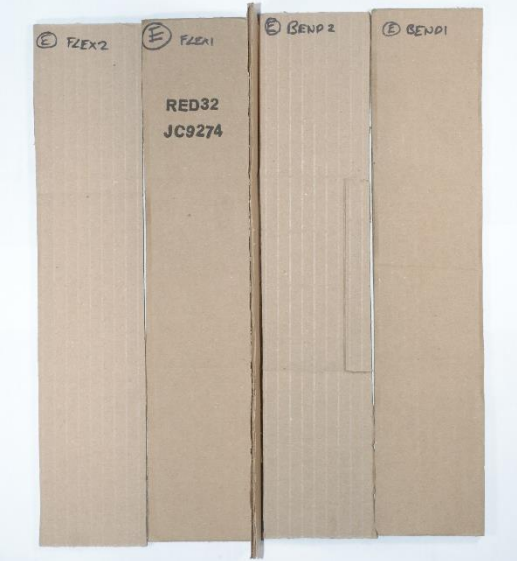


Figure 2: Graphical Representation of Flexural-Buckling Results – All Samples

5. Appendices

5.1 Sample Photo Collection



Sample D – RED24 JC9273	Sample E – RED32 JC9274	Sample F – K1 22 202308
		
Sample G – K2 GK 276176	Sample H – K3 A/C 2 279477 HC	Sample I – K4 530367
		



5.2 Sample, Testing, and Client Information

Sample Information	
Date received	2026/01/23
Did we receive Pre-Machined Samples from the Client (Yes/No)	Samples provided were pre-cut cardboard sections
Sampling method	As Received
Personnel Responsible for Sampling (Sample Extraction)	Rebul Crating Solutions
Time of the Sampling Conducted (Sample Extraction)	N/A
Testing Information	
Date Testing Commenced:	2026/01/27
Room Temperature before Test Commences:	± 23 °C
Name of Equipment Used and Laboratory Location Name:	Instron 3369 Tensile/Compression Tester
Location of Testing: (Including any subcontracting work location)	Cape Town, Mowbray (OEMES)
Deviations, Additions, or Exclusions from the Test Method, if any:	N/A
Customer Data or Deviations Requested, if applicable:	N/A
Statement of Conformity Requests or Deviations, and Decision Rules, if applicable:	N/A
Measurement of Uncertainty	Available on request for accredited tests only.

Note: The machining of samples is carried out by an approved subcontractor.

5.3 Revision History

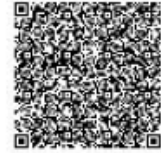
Rev.	Date	Reason for the Revision	Affected Pages	Originator
00	2025/02/06	First Issue	All	Marcelle de Waal

5.4 Test Specifications

One Eighty Materials Engineering Solutions (Pty) Ltd is SANAS 17025 accredited for the test methods indicated below. Mechanical testing that falls under the SANAS accreditation has been approved by Bureau Veritas.

☐ OE-TSP-03 TM01 Tensile Test Metals
☐ OE-TSP-03 TM03 Impact Test Metals
☐ OE-TSP-03 TM05 Vickers Hardness Test
☐ OE-TSP-03 TM06 Spectrographic Analysis
☐ OE-TSP-03 TM08 Microstructural Analysis
☐ OE-TSP-03 TM011 Bend Test
☐ OE-TSP-03 TM19 Portable Hardness Test
☐ OE-TSP-03 TM13 Ferrite Count and Ferrite Percentage
☐ OE-TSP-03 SOP 13 Micro Examination Determination of microstructure in the field
☐ OE-TSP-03 TM15 Determination of Resistance to Intergranular Corrosion of Duplex Stainless Steels
☐ OE-TSP-03 TM16 Intermetallic Phase Detection
☐ OE-TSP-03 TM18 Detection of Susceptibility of Austenitic Stainless Steels to Intergranular Corrosion
☐ OE-TSP-03 TM22- ASTM G48 Corrosion Testing
☐ OE-TSP-03 TM24 Macro Examination Determination of Weld Defects and Fillet Weld Size
☐ OE-TSP-03 TM26- PMI (Handheld XRF) X-MET 8000
☐ OE-TSP-03 TM27- ASTM G28 Corrosion Testing
Non-accredited tests: 3-point Bending and Flexural Compression Testing
Subcontracted work: None

Note on subcontracted work: A portion of this test has been outsourced to an approved and accredited subcontractor as per section OE-MSP04 SF07 and OE- MSP SF01 of the quality management system.



Marine & Offshore

Certificate number: SMS.LAB.320/1039/10/02/B.0

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RECOGNITION OF TEST LABORATORY

ONE EIGHTY MATERIALS TESTING (PTY) LTD.
Cape Town - SOUTH AFRICA

Summary of the range of the recognition which is detailed in the subsequent page(s):

1. Various test of metal material (Bend Test, Chemical Analysis, Chemical Analysis using X-MET 800, Corrosion Test, Hardness Testing, Impact Testing, Macro Examination, Micro Examination, Microstructural Analysis, Portable Hardness Test, Tensile Test)
2. Welding Approval Test
3. Special test (CTOD test, Various Corrosion Test, Product Failure Analysis, etc.)

This certificate is issued to attest that Bureau Veritas Marine & Offshore has performed, at the above company's request and in compliance with the requirements of NR320, a satisfactory assessment of the testing facilities and associated quality procedures related to the range of the recognition.

This certificate will expire on: 01 Sep 2027

For Bureau Veritas Marine & Offshore,
At BV DURBAN, on 20 Aug 2023,
Jeremy BROWN

This certificate was created electronically and is valid without signature



This certificate remains valid until the date stated above, unless cancelled or revoked, provided the conditions indicated in the subsequent page(s) are complied with. This certificate is issued within the scope of the General Conditions of Bureau Veritas Marine & Offshore available on the internet site www.veristar.com. Any person not a party to the contract pursuant to which this document is delivered may not assert a claim against Bureau Veritas Marine & Offshore for any liability arising out of errors or omissions which may be contained in said document, or for errors of judgement, fault or negligence committed by personnel of the Society or of its Agents in establishment or issuance of this document, and in connection with any activities for which it may provide.

The electronic version is available at: <http://www.veristarpm.com/Veristarpm/ViewPublicPdfRecognition.jsp?id=bvjb8urywi>
BV Mod. Ad E 886 June 2017

This certificate consists of 2 page(s)

THE SCHEDULE OF RECOGNITION**1. RANGE OF THE RECOGNITION**

Type of test	Test standard	Test witnessing requirements
☐ Bend Test	ASME IX, AWS D1 ASTM A370, ABS Rules and BS EN ISO	Tests to be witnessed -as practicable at each periodical audit
☐ Chemical Analysis	ASTM E415 and A751	Tests to be witnessed -as practicable at each periodical audit
☐ Chemical Analysis using X-MET 8000	ASTM A 751 and ASTM E1085	Tests to be witnessed -as practicable at each periodical audit
☐ Corrosion Test	ISO 3651-2 & ASTM A262C & ASTM G48 & ASTM A923C	Tests to be witnessed -as practicable at each periodical audit
☐ Hardness Testing	ASTM E384 & ASTM E140	Tests to be witnessed -as practicable at each periodical audit
☐ Impact Testing	ASTM E23, ISO 148-1	Tests to be witnessed -as practicable at each periodical audit
☐ Macro Examination	ASTM E340, ISO 5817	Tests to be witnessed -as practicable at each periodical audit
☐ Micro Examination	ASTM E1351	Tests to be witnessed -as practicable at each periodical audit
☐ Microstructural Analysis	ASTM E3 & ASTM E562 and ASTM E1245	Tests to be witnessed -as practicable at each periodical audit
☐ Portable Hardness Test	ASTM A956 and ASTM E110	Tests to be witnessed -as practicable at each periodical audit
☐ Tensile Testing	ASTM E8, BS EN ISO 6892-1 BS EN ISO 10002-1 and ASTM A370	Tests to be witnessed -as practicable at each periodical audit

2. LIMITATIONS

Bureau Veritas Marine & Offshore is to be informed immediately of any modification to testing facilities and associated quality procedures in order to agree on appropriate actions.

ONE EIGHTY MATERIALS TESTING (PTY) LTD. has to carry out and report the tests in compliance with the relevant testing standard(s) and has to make the necessary arrangements to comply with the witnessing requirements agreed with Bureau Veritas Marine & Offshore.

ONE EIGHTY MATERIALS TESTING (PTY) LTD. has to apply for the periodical audits as agreed with Bureau Veritas Marine & Offshore.

3. REMARKS

Nil.

***** END OF CERTIFICATE *****