

TEST REPORT

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Date: 08 September 2021

Your Ref: -

Our Ref: MM-8500178599/TYH/1-2

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Subject : Testing of grout spliced with reinforcement steel bar submitted by Splice Sleeve (S) Pte Ltd on 26 August 2021.

Tested For : **SPLICE SLEEVE (S) PTE LTD**
601 Sims Drive
#01-06 Pan-I Complex
Singapore 387328

Attn: Mr. Woo Zhen Yang

Project : ISO 15835 – NMB Splice Sleeve Low Cycle Testing

Date and Place of Test : 02 September 2021 at SetSCO Laboratory

Method of Test : ISO 15835-1: 2018 (E) – Low-Cycle Reverse Loading Test



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LA-1993-0051-C LA-1998-0144-D
LA-1993-0067-G LA-2000-0181-F
LA-1994-0068-A LA-2012-0519-E
LA-1987-0001-B LA-1987-0001-B-1

Description of Sample : Three (03) pieces of grout spliced with reinforcement steel bar were received as follows:

Sample Reference:	Ø 40.0mm
Sample Marking:	SA1, SA2, SA3
Coupler Supplier: (Said to be)	Splice Sleeve (S) Pte Ltd for NMB Splice Sleeve and SS Mortar,
Type of Coupler:	NMB Splice Sleeve Coupler
Coupler Marking:	13/14 UX(SA)
Batch Code:	0A03
Preparation Date and Age of Sample: (Said to be)	2 nd August 2021 / 26 Days
Reinforcement Steel Bar Heat Number: (Said to be)	L21NH03722
Reinforcement Steel Bar Supplier: (Said to be)	NatSteel Holdings Pte Ltd
Reinforcement Steel Bar Source: (Said to be)	NatSteel Holdings
Reinforcement Steel Bar Test Standard and Grade:	SS 560: 2016 and Grade B500B
Type of Extensometer:	MAYES, Demountable mechanical strain gauge
Gauge Length:	200mm
Stress-Strain Results of Reference Bar:	To Determine from Mill Certificate if not provided.

Results : Low-Cycle Reverse Loading Test
The tested sample met the requirements of ISO 15835-1: 2018 (E) specification.
Refer to Table, Graphs & Photographs attached.

Witness : Mr. Sukhdev Singh [Splice Sleeve (S) Pte Ltd]



TAN YAN HUI
Testing Officer



YE TUN NAING
Assistant Engineer (Mechanical Testing)
Mechanical Technology Division

Results:

Table 1: Low-Cycle Reverse Loading Test

Sample Reference	NMB Splice Sleeve Coupler			ISO 15835-1:2018 (E) Requirements
	Ø 40.0mm			
	S1	S2	S3	
Coupler Length (mm)	620			-
Coupler Outside Diameter, (mm)	82			
Length of free bar between the grips and the coupler, (mm)	380			
Gauge Length for the Measurement of slip, L _g (mm)	700			
Nominal Size (mm) #	40.0			
Nominal Cross-sectional area, S _o (mm ²)	1256.64			
Residual Elongation Value After Low Cycle Loading to 0.9R _{eH,spec} (##) Tension and Down to 0.5R _{eH,spec} (##) in Compression Alternating 20 Times "20, (mm)	0.09	0.11	0.10	Max 0.30
Strain Cycles in Stage 2 and 3	Without Failure			-
Maximum Load, P (kN)	835.4	834.2	834.1	-
$\frac{(P \times 1000)}{S_o} (N / mm^2)$	664.8	663.8	663.8	Min. 572.4 ^{Note 1}
Agt (%)	14.0	12.5	11.0	Min. 3.5
Position of Fracture ###	Fractured at the reinforcement steel bar (Inside the mechanical splice length)		Fractured at the reinforcement steel bar (Outside the mechanical splice length)	-

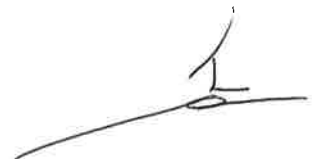
(1kN = 102 kgf)

"#" - Based on client's sample reference

"##" - R_{eH, spec} = 500 MPa

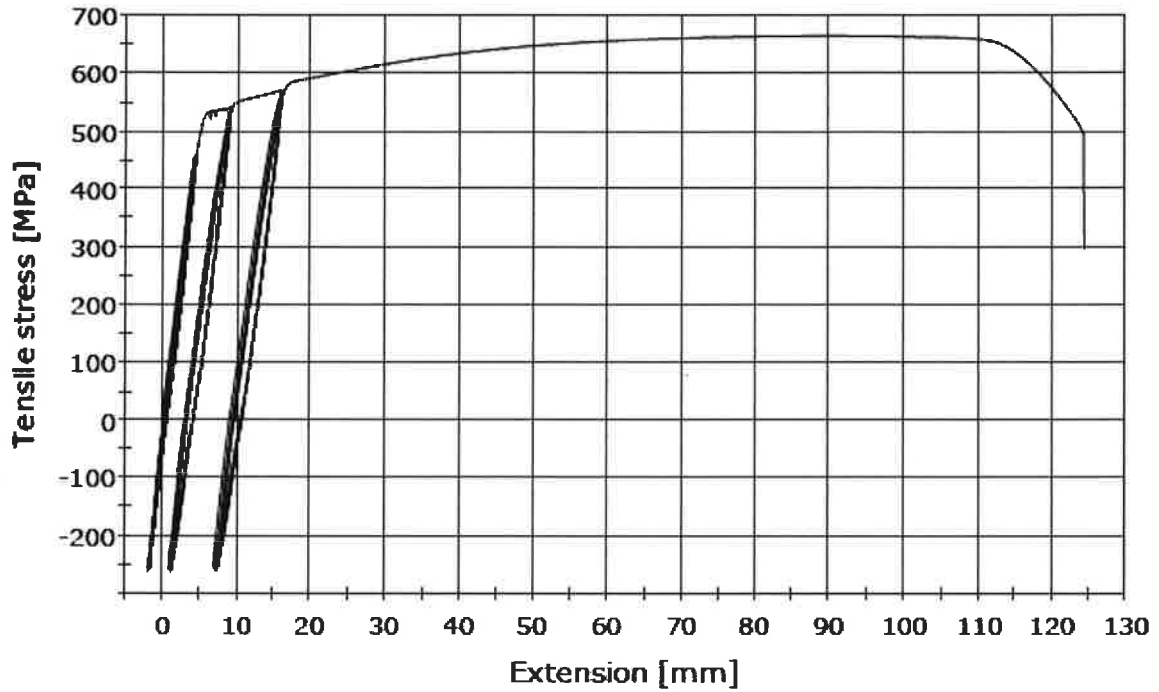
"###" - Length of the mechanical splice define as coupler length plus two times the nominal diameter at both ends of the coupler.

"Note 1" - The tensile strength of the mechanical splice shall be at least R_{eH} x (R_m/R_{eH})_{spec}. R_{eH} value is based on the reference bar / mill certificate provided.

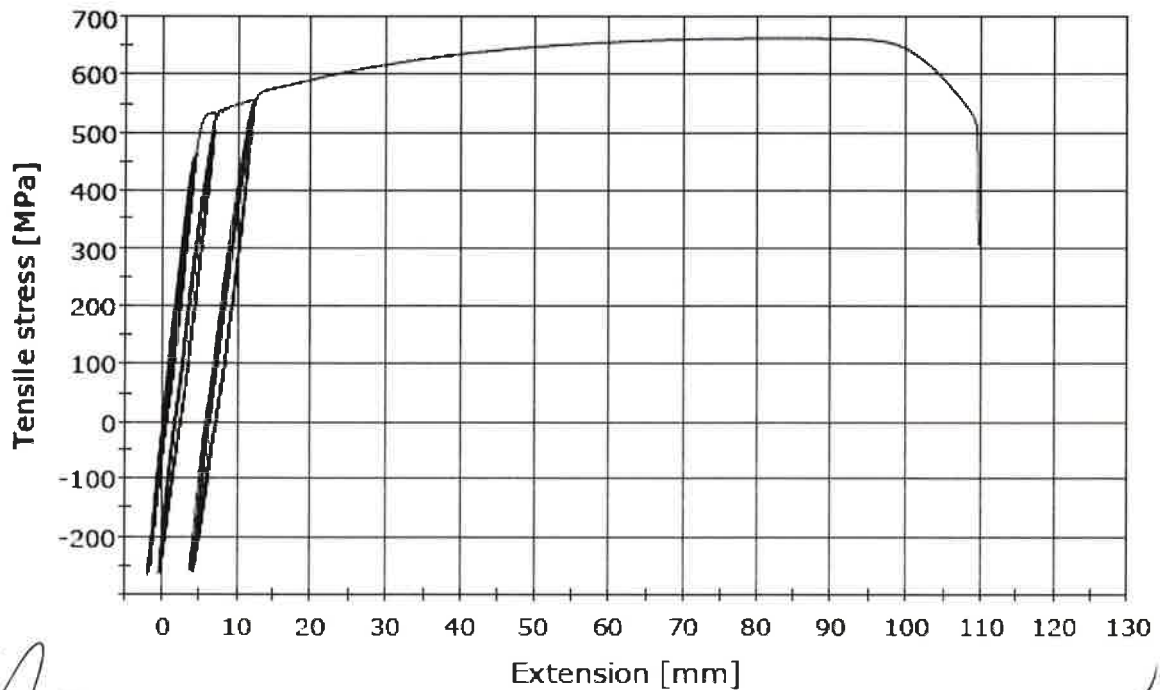
Specimen Label
— Ø 40.0mm-S1

Tensile Stress vs Extension



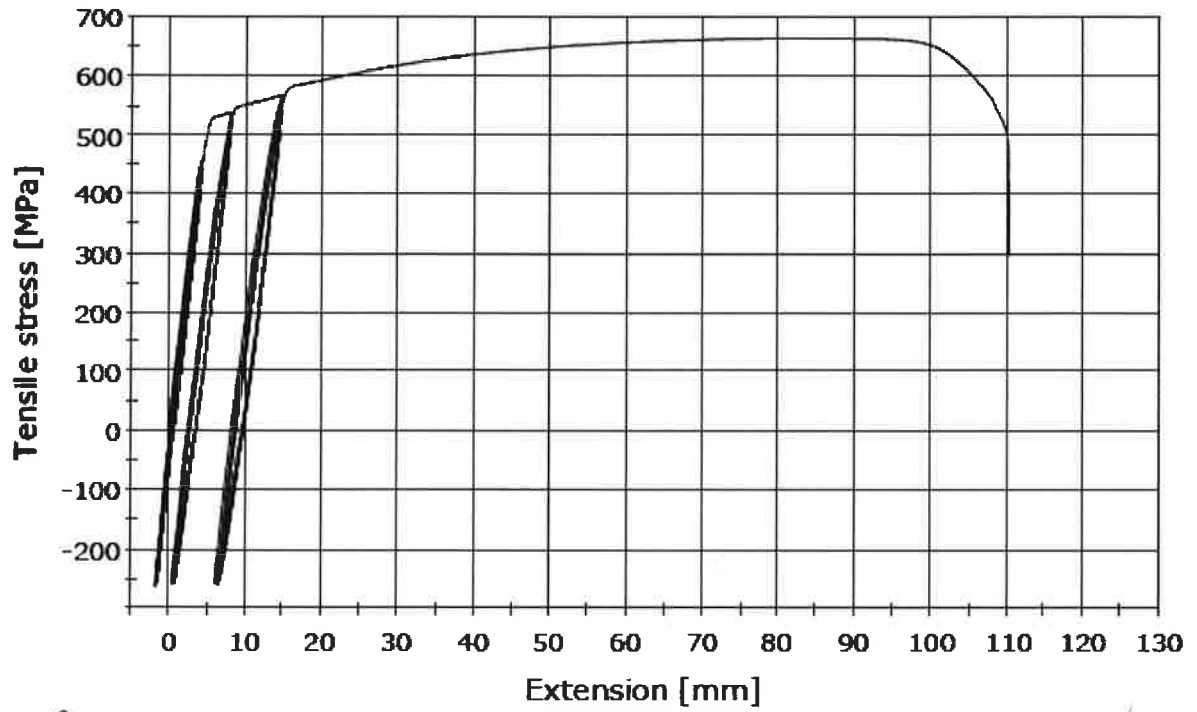
Specimen Label
— Ø 40.0mm-S2

Tensile Stress vs Extension



Specimen Label
— Ø 40.0mm-S3

Tensile Stress vs Extension



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Appendix 1:



Photograph 1 show samples marking.



Photograph 2 show samples submitted.



Photograph 3 show tested samples.

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Appendix 2:

Information & Preparation of Coupler By Supplier (said to be).

Reference and Revision number of the manufacturer catalogue: Singapore Version 3.1

Name of individual who prepared the test piece: Edwin Khoo

Details of assembly of the test pieces

(Further details to reference to NMB Splice Sleeve System User's Manual Version 2018.05STD):

1. Prepare and insert Inlet/Outlet PVC pipes into sleeves.
2. Ensure received rebars are according to embedment length (ISO 15835 standard specified length).
3. Insert both end rebars up to sleeve embedment length.
4. Lay specimens onto pallet and adjust shim level.
5. Use Spirit Level to ensure specimens and rebars are level.
6. Ensure both rebars are aligned vertically.
7. Prepare Rubber Stoppers on Inlet and Outlet holes.
8. Mix whole bag of SS Mortar (15kg/bag) with 2.1 ~ 2.3 litres of water.
9. Perform flowability test by using PVC cone (Dia 50mm x 100mm) on flow board (within 155 to 235 mm).
10. Once flow is acceptable, grout the sleeve by pumping slowly through the Inlet hole until outflow from outlet hole.
11. Set specimens aside for curing undisturbed to achieve up to 28 days strength.



Example Photo

MILL TEST CERTIFICATE

Delivery No : 1041427996
Customer : SPLICE SLEEVE (S) PTE LTD
Contract No : 1020017547
Job Site : SUPPLY OF REBAR TO SPLICE SLEEVE (S) PTE LTD

Date : 22.07.2021
Sheet-No : 2 of 2
Cert/Sales order : 1031349430
BBS No : 072084

STANDARD:SS560:2016					Commodity : HOT ROLLED DEFORMED BAR GRADE B500B																	TENSILE PROPERTIES						Remark
Size (mm)	Batch No	Heat No.	No. of Bundle/coil	No. of Pcs/Bundle	Wt (MT)	Mass Tol (%)	Production Order No	CHEMICAL PROPERTIES														YS (MPa)	TS (MPa)	Ratio	EL (%)	Agt (%)	Bend/Rebend Test	
								C %	P %	Mn %	Si %	S %	Ni %	CR %	Cu %	Sn %	Mo %	V %	N %	Al %	Ceq %							
40.00	R21NH05041	L21NH03722	0	18	0.237	-4.03	111056538	0.200	0.020	0.730	0.208	0.032	0.123	0.138	0.340	0.017	0.036	0.003	0.010	0.004	0.39	529.00	646.00	1.22	16.50	9.60	Passed	
						-4.10																527.00	646.00	1.23	16.70	9.90	Passed	
						-4.07																530.00	648.00	1.22	16.30	9.30	Passed	
Geometry and Surface Condition : OK							Radiation Test: PASSED							YS-Yield Stress, TS-Tensile Strength, EL-Elongation														
Ceq = C + Mn/6 + (Cr+V+Mo)/5 + (Ni+Cu)/15																												
*A higher nitrogen content maybe used if sufficient quantities of nitrogen-binding elements are present.																												