NEMO|etc.
353 Christian Street, Unit #13
Oxford, CT 06478
(203) 262-9245

ENGINEER EVALUATE TEST CONSULT

Laboratory Report 4r-QAI-21-SSTHP-01.A.R1

Physical Properties Testing

of

Tufdek™ (nominal 60-mil)

produced in

Saginaw, MI

in accordance with

Selected Tests as Requested by QAI Laboratories

Prepared for: **TUFF Industries, Inc.**
9570 Bottom Wood Lake Road
Lake Country, BC V4V 1S7
c/o: Byran Hughes

Test Lab: **NEMO|etc.**
10 Mauney Court
Columbia, SC 29201

Date of Issuance: **2022-08-09**
Revision 1: **2024-01-17**

NEMO|etc.®

LABORATORY REPORT

PRODUCT	BY	MANUFACTURING LOCATION
Tufdek™ (nominal 60-mil)	TUFF Industries, Inc.	Saginaw, MI

PROJECT NO.	MD NOTIFICATION	TRACEABILITY			RECEIVED	TEST DATES	
		VIA	BY	DATE		START	END
4r-QAI-21-SSTHP-01	N/A	Sampling Records	QAI Laboratories	2021-07-16	2022-05-04 2022-05-09	2021-11-30	2022-05-10

Scope: Physical properties testing of Tufdek™ (nominal 60-mil) in accordance with selected test methods specified by QAI Laboratories.

RESULTS: Tufdek™ (nominal 60-mil)

Property			Test Data						Results		QAI Specified Criteria
			1	2	3	4	5	6	Avg.	SD	
Static puncture resistance over ASTM C578, Type IX EPS		kg	Pass	Pass	Pass	Pass	–	–	**Pass**	N/A	Pass 15 (33 lbf)
Dynamic puncture resistance Over ASTM C578, Type IX EPS		J	Pass	Pass	Pass	Pass	–	–	**Pass**	N/A	Pass 20
Tearing strength	N	MD	362	360	357	332	401	–	**362**	25	≥ 200 (45 lbf)
		XMD	391	383	322	387	369	–	**370**	28	
Low temperature impact	-30°C	MD	Pass	Pass	Pass	Pass	Pass	Pass	**Pass -30°C**	N/A	No cracks
			Pass	Pass	Pass	Pass	–	–			
		XMD	Pass	Pass	Pass	Pass	Pass	Pass	**Pass -30°C**	N/A	
			Pass	Pass	Pass	Pass	–	–			
Low temperature bend	-40°C	MD	Pass	Pass	Pass	–	–	–	**Pass -40°C**	N/A	No cracks
		XMD	Pass	Pass	Pass	–	–	–	**Pass -40°C**	N/A	
Low temperature crack bridging	-26°C		Pass	Pass	Pass	Pass	Pass	–	**Pass**	N/A	No cracks
POST HEAT AGING:											
Low temperature impact	-20°C	MD	Pass	Pass	Pass	Pass	Pass	–	**Pass -20°C**	N/A	No cracks
		XMD	Pass	Pass	Pass	Pass	Pass	–	**Pass -20°C**	N/A	
ACCELERATED WEATHERING (2,000 HOURS):											
Static puncture resistance over ASTM C578, Type IX EPS		kg	Pass	Pass	Pass	Pass	–	–	**Pass**	N/A	Pass 15 (33 lbf)
Dynamic puncture resistance over a rubber stopper and stainless steel		J	Pass	Pass	Pass	Pass	Pass	Pass	**Pass**	N/A	Pass 20
Low temperature impact	-10°C	MD	Pass	Pass	Pass	Pass	Pass	–	**Pass -10°C**	N/A	No cracks
		XMD	Pass	Pass	Pass	Pass	Pass	–	**Pass -10°C**	N/A	
Low temperature bend	-25°C	MD	Pass	Pass	Pass	–	–	–	**Pass -25°C**	N/A	No cracks
		XMD	Pass	Pass	Pass	–	–	–	**Pass -25°C**	N/A	

COMPLIANCE STATEMENT: The following pertains to production at the Plastatech manufacturing facility in Saginaw, MI.

- NEMO|etc. has conducted physical properties testing of Tufdek™ (nominal 60-mil) in accordance with selected test methods, as specified by QAI Laboratories, with results presented herein.

Signed: 

Michael Aitchison
Director of Quality & Engineering

Signed: 

Robert Nieminen, P.E.
President

REPORT HISTORY:

Date	Event	Notes	Authorized By:
2022-07-06	DRAFT 1 issued	For client review	FR
2022-08-09	FINAL issued	After client review	FR
2024-01-16	DRAFT REV1 issued	For client review	RN
2024-01-17	REV1 issued	After client review; update client-contact information resulting from data release, correct product trade name nomenclature	RN

Appendix 1: Statement of Limitation
Appendix 2: Decision Rule 1
Appendix 3: Test & Equipment Log

APPENDIX 1: STATEMENT OF LIMITATION

The results presented are applicable solely to the products tested herein.

APPENDIX 2: DECISION RULE 1

All results reported to the client reflect observed values without incorporating measurement uncertainty. Determination of conformity to specifications will depend on acceptance limits, where results will be declared to pass if within the limits, and fail if outside the limits.

APPENDIX 3: TEST & EQUIPMENT LOG

			Test Equipment		Calibration	
Property		Base Method	Description	Asset #	Current	Next
Static puncture resistance		D5602	Static puncture apparatus	0619	–	–
			Mettler Toledo balance	0514	2021-03-17	2022-03-17
Dynamic puncture resistance		D5635	Dynamic puncture apparatus	0620	–	–
Tearing strength		D751, procedure B, Tongue Tear	Instron 5969	0595	2021-04-21	2022-04-21
Low temperature impact	-30°C	D1790	So Low freezer	0604	2021-03-11	2022-03-11
			Impact resistance tester	0625	–	–
Low temperature bend	-40°C	D2136	So Low freezer	0240	2021-03-11	2022-03-11
			NEMO low temp bend	0686	–	–
Low temperature crack bridging		C1305 per C836	ATS crack cycling controller	0258	–	–
			Digi-Sense thermometer	0685	2021-07-07	2022-07-07
Heat Aging (HA)	176°F, 56 days	D3045	Lunaire oven #1	0215	2022-03-09	2023-03-09
Low temperature impact	-20° C	D1790	So Low freezer	0604	2022-03-08	2023-03-08
			Impact resistance tester	0625	–	–
Accelerated Weathering (AW)	2,000 hrs	G154	Atlas Ci5000	0599	2021-02-02	2023-02-02
Static puncture resistance		D5602	Static puncture apparatus	0619	–	–
			Mettler Toledo balance	0514	2022-03-08	2023-03-08
Dynamic puncture resistance		D5635	Dynamic puncture apparatus	0620	–	–
Low temperature impact	-10° C	D1790	So Low freezer	0604	2022-03-08	2023-03-08
			Impact resistance tester	0625	–	–
Low temperature bend	-25° C	D2136	So Low freezer	0240	2022-03-08	2023-03-08
			NEMO low temp bend	0686	–	–

-END OF REPORT-