



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

ENGINEER TEST CONSULT

Laboratory Report 4r-CGT-20-SSTHP-01.C

Physical Properties Testing

of

Econodek - Premium Series

produced in

Cambridge, ON

in accordance with

CGSB 37.54-95

Prepared for: Tuff Industries, Inc.

9570 Bottom Wood Lake Road Lake Country, BC V4V 1S7, Canada

c/o: Bryan Hughes

Test Lab: NEMO etc.

10 Mauney Court Columbia, SC 29201

Date of Issuance: 2024-04-05









Tuff Industries, Inc.

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LABORATORY REPORT

CUSTOMER OBJECTIVE

Establish physical property data in accordance with codified material standards.

TESTING SCOPE

Physical properties testing in accordance with CGSB 37.54-95.

PRODUCT BY Manufacturing Location

Econodek - Premium Series Tuff Industries Cambridge, ON

TEST PROGRAM

PROJECT DURATION PERSONNEL

Number: 4r-CGT-20-SSTHP-01 Authorized: 2020-04-29 Nemo: D. Rhodes

CUSTOMER PO: 4500049149 SAMPLING: N/A MD NOTIFICATION: N/A MATERIALS ON HAND: N/A

TEST MATERIAL ROUTING

Materials Received: 2020-06-05

 VIA:
 Per Customer
 TEST START:
 2020-07-01

 BY:
 Contact Customer
 TEST END:
 2021-03-12

APPENDICES

Appendix 1 Statement of Limitation

Appendix 2 Decision Rule 1

Appendix 3 Manufacturing Traceability & Test Material Routing Appendix 4 Tests, Standards, Equipment & Outsourced Log

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RESULTS ¹ :	Econo	dek - Prei	mium S	nium Series Cambridge, ON					CGSB 37.54-95 Type 4, Class B		
_		TEST DATA					RESULTS				
PROPERTY			1	2	3	4	5	Avg. SD		CRITERIA	
Thickness	mm		1.4	1.4	1.4	1.4	1.5	1.4	0.0	≥ 1.2	
Coating thickness	mm		0.4	0.4	0.4	0.4	0.4	0.4	0.0	≥ 0.4	
Breaking strength	kN/m		58	57	57	57	57	57	1	- ≥35	
breaking strength	KIN/III	XMD	49	46	47	48	49	48	1	2 33	
Elongation at break	%	MD	29	28	28	28	29	29	0	- ≥ 15	
Eloligation at break	70	XMD	24	22	23	26	25	24	2	2 15	
Lap joint strength	kN/m	control	53	52	49	50	50	51	2	≥ 36 (75% of breaking strength control)	
Lap Joint Strength	KIN/III	post-BWI	40	38	35	40	36	38	2	≥ 33 (70% of breaking strength control)	
Low temperature imp	act	-30°C	Pass	Pass	Pass	Pass	Pass	Pass	N/A	Pass 8 of 10	
Low temperature imp	acı	30 C	Pass	Pass	Pass	Pass	Pass	rass	IN/A	F855 6 01 10	
Low temperature flexibility -40°C			Pass	Pass	Pass	_	_	Pass	N/A	No fractures or cracks	
Water vapor transmission g/m ² *24 hrs			1.1	1.1	1.1	_	_	1.1	0.0	≤ 4.0	
Dimensional change	%	MD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	≤ 0.5	
without loading	/0	XMD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2 0.3	
Dimensional change	%	MD	0.2	_	_	_	_	0.2	N/A	≤ 0.5	
with loading	/0	XMD		_	_	_	_	0.2	N/A	≤ 0.2	
Cone penetration N		460	459	461	460	460	460	1	≥ 30		
POST-WATER ABSOF	RPTION:										
Mass increase	%		1.4	1.7	1.2	_	_	1.4	0.3	≤ 3.0	
	1.51/	MD	52	55	54	55	53	54	1	≥ 51 (90% of control)	
Breaking strength	kN/m	XMD	42	42	45	44	42	43	1	≥ 43 (90% of control)	
		MD	28	29	29	29	29	29	0	≥ 26 (90% of control)	
Elongation at break	%	XMD	28	27	28	26	26	27	1	≥ 22 (90% of control)	
POST-HEAT AGING:		·			·						
Visual	Pass	Pass	Pass	Pass	Pass	Pass	N/A	No delamination			
	LAL /	MD	60	60	59	59	56	59	2	≥ 51 (90% of control)	
Breaking strength	kN/m	XMD	45	44	45	46	45	45	1	≥ 43 (90% of control)	
Flancation 11	0/	MD	27	27	27	27	28	27	0	≥ 26 (90% of control)	
Elongation at break	%	XMD	25	26	25	26	24	25	1	≥ 22 (90% of control)	
Low temperature flexibility -40°C			Pass	Pass	Pass	_	-	Pass	N/A	No fractures or cracks	

¹ All properties except overall thickness reflect performance of nominal 50-mil material, which has been found through criticality testing and analysis to be extendable to the nominal 60-mil material.

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RESULTS ² : Econode	mium Series Ca				Ca	mbridg	e, ON	CGSB 37.54-95 Type 4, Class B			
P		TEST DATA					RESULTS		C		
PROPERTY		1	2	3	4	5	Avg. SD		Criteria		
Post-Accelerated Weathering 1 (Xenon Arc Light Exposure 5,000 hours):											
Visual		Pass	Pass	Pass	Pass	Pass	Pass	N/A	No cracks, blisters, or color change		
Breaking strength kN/m	XMD	46	46	45	46	45	45	1	N/A		
Elongation at break %	XMD	21	21	21	21	25	22	2	≥ 22 (90% of control)		
Low tomporature impact	-20°C	Pass	Pass	Pass	Pass	Pass	Pass	N/A	Pass 8 of 10		
Low temperature impact	-20 C	Pass	Pass	Pass	Pass	Pass			Pass 8 01 10		
Low temperature flexibility -40°C		Pass	Pass	Pass	_	_	Pass	N/A	No fractures or cracks		
POST-ACCELERATED WEATHER	NG 2 (U'	V Expo	SURE 5,	000 нс	urs):						
Visual	Pass	Pass	Pass	Pass	Pass	Pass	N/A	No cracks, blisters, or color change			
Breaking strength kN/m	XMD	46	48	49	49	48	48	1	N/A		
Elongation at break %	XMD	22	24	21	21	21	22	1	≥ 22 (90% of control)		
Low temperature impact -20°C		Pass	Pass	Pass	Pass	Pass	D	N1 / A	Pass 8 of 10		
		Pass	Pass	Pass	Pass	Pass	Pass	N/A			
Low temperature flexibility -4	Pass	Pass	Pass	_	_	Pass	N/A	No fractures or cracks			

COMPLIANCE STATEMENT

Econodek - Premium Series, as produced in Cambridge, ON, Canada has demonstrated compliance with requirements of CGSB 37.54-95, Type 4, Class B.

Signed:	Hal	Signed:
-	David Carey	Robert Nieminen, P.E.
	Small Scale Section Lead	President

REPORT HISTORY:

 DATE
 EVENT
 NOTES
 AUTHORIZATION

 2024-04-05
 FINAL
 New report per directive of program sponsor, supported by SPE
 RN

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TRPT- 0210 TRPT- 0048 REVISION HISTORY: LOG-0700 RELEASED BY: MDA

-END OF REPORT-

² All properties except overall thickness reflect performance of nominal 50-mil material, which has been found through criticality testing and analysis to be extendable to the nominal 60-mil material.

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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 customer 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: MANUFACTURING TRACEABILITY & TEST MATERIAL ROUTING

Manufacturing traceability for component tests is confirmed by counter-signed contractual agreement or by signed statement from customer, retained in the custody of Nemo|etc.

Test materials routing is included if randomly sampled, or if the sample bears Nemo|cert. certification mark. Random sampling is acceptable if conducted by an ISO/IEC 10720 or ISO/IEC 10725 accredited entity, which includes sampling on its Scope of Accreditation, and is independent of the manufacturer and the customer. If conducted by Nemo|etc., third-party random sampling is conducted in accordance with the sampling plan detailed in SOP-0005, and as stated in ICC-ES AC85.

Thickness	Α	APPENDIX 4:	TESTS, S	TANDARDS, E	QUIPMENT & OUTSOURCED I	Log		
Thickness	CGSI	37.54-95			TEST EQUIPMENT		CALIBE	RATION
Coating thickness	PROPERTY		SECTION	BASE METHOD	DESCRIPTION	Asset #	Pre-test	NEXT
Dodd/Strain properties	Thickness		7.3.1, 7.3.2	D751	E.J. Cady micrometer	0637	2020-04-28	2021-04-2
Lap joint strength Boiling water immersion (BWI) 7 days, 100°C Boiling water immersion (BWI) 7 days, 100°C A3.5 D751 Instron 4465 0235 2020-04-01 2021-04-2 Lap joint strength post-BWI 7.3.5 D751 Instron 4465 0235 2020-04-01 2021-04-2 Low temperature impact 30°C A3.6 D1790 SPI impact tester 0625 − − Veritas balance 0526 2020-03-17 2021-03-2 Veritas balance 0526 20	Coating thickness		7.3.2		Meiji microscope	0232	_	_
Bolling water immersion (BWI)	Load/Strain properties		7.3.4	D751	Instron 5969	0595	2020-04-01	2021-04-30
Lap joint strength post-BWI 7.3.5 D751 Instron 4465 0235 2020-04-01 2021-04-2 Low temperature impact -30°C 7.3.6 D1790 SPI impact tester 0625 − − Veritas balance 0526 2020-03-17 2021-03-2 Low temperature flexibility -40°C 7.3.8 D2136 So Low freezer 0604 2020-03-17 2021-03-2 Water vapor transmission 7.3.10 E96 Ohaus balance 0334 2020-03-17 2021-03-2 Water Absorption (WA) 7 days, 70°C 7.3.11 D570 Boekel water bath 0522 2020-03-17 2021-03-2 Mass increase post-WA 7.3.11 Ohaus balance 0334 2020-03-17 2021-03-2 Load/Strain properties post-WA 7.3.12 Fischer Scientific oven 0312 2020-03-17 2021-03-2 Dimensional change with loading 7.3.12 Fischer Scientific oven 0312 2020-03-17 2021-03-2 Dimensional change with loading 7.3.13 Fischer Scientific oven 0312 2020-03-17 2021-03-2 Cone penetration 7.3.14 Instron 5969 0595 2020-04-01 2021-03-2 Cone penetration 7.3.14 Instron 5969 0595 2020-04-01 2021-03-2 Load/Strain properties post-HA 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-03-2 Load/Strain properties post-HA 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-03-2 Load/Strain properties post-HA 7.3.8 D2136 So Low freezer 0604 2020-03-17 2021-03-2 Load/Strain properties post-AW1 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-03-2 Low temperature flexibility -40°C post-AW1 7.3.6 D750 SPI impact tester 0625 Verified Verified Verified Verified Accelerated Weathering 1 (AW1) 5000 hrs 7.3.7 D2565 Xenon Arc Lamp 0599 2019-02-02 2023-02-04-04 2021-03-2 Low temperature flexibility -40°C post-AW1 7.3.6 D750 SPI impact tester 0625 Verified Verif	Lap joint strength		7.3.5	D751	Instron 4465	0235	2020-04-01	2021-04-30
Low temperature impact	Boiling water immersion (BWI) 7 (days, 100°C	7.3.5		_	_	-	_
Veritas balance Veritas balance Sociation Soci	Lap joint strength	post-BWI	7.3.5	D751	Instron 4465	0235	2020-04-01	2021-04-30
New temperature flexibility -40°C 7.3.8 D2136 So Low freezer NEMO 1-in. mandrel 0626 - -	Low temperature impact	-30°C	7.3.6	D1790	SPI impact tester	0625	-	_
NEMO 1-in. mandrel 0626 -					Veritas balance	0526	2020-03-17	2021-03-17
Water vapor transmission 7.3.10 E96 Ohaus balance 0234 2020-03-17 2021-03-7 Water Absorption (WA) 7 days, 70°C 7.3.11 D570 Boekel water bath 0522 2020-03-17 2021-03-7 Mass increase post-WA 7.3.41 D751 Instron 5969 0595 2020-04-01 2021-03-7 Dimensional change without loading 7.3.12 Fischer Scientific oven 0212 2020-03-17 2021-03-7 Dimensional change with loading 7.3.13 Fischer Scientific oven 0212 2020-03-17 2021-03-7 Caliper 0511 2020-03-17 2021-03-7 2021-03-7 2021-03-7 2021-03-7 Cone penetration 7.3.14 Instron 5969 0595 2020-04-01 2021-03-7 Load/Strain properties post-HA 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-03-7 Low temperature flexibility -40°C post-HA 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-03-7 Load/Strain properties post-AW1 7.3.4 D751 Instron 5969 0595 2020-04-01 </td <td>Low temperature flexibility</td> <td>-40°C</td> <td>7.3.8</td> <td>D2136</td> <td>So Low freezer</td> <td>0604</td> <td>2020-03-17</td> <td>2021-03-17</td>	Low temperature flexibility	-40°C	7.3.8	D2136	So Low freezer	0604	2020-03-17	2021-03-17
Water Absorption (WA) 7 days, 70°C post-WA (Mass increase) 7.3.11 post-WA D570 post-WA Boekel water bath 0522 post-WA 2021-03-17 post-WA 2020-03-17 post-WA 2021-03-17 post-WA 202					NEMO 1-in. mandrel	0626	_	_
Mass increase	Water vapor transmission		7.3.10	E96	Ohaus balance	0234	2020-03-17	2021-03-17
Dimensional change without loading	Water Absorption (WA) 7	days, 70°C	7.3.11	D570	Boekel water bath	0522	2020-03-17	2021-03-17
Dimensional change without loading	Mass increase	post-WA	7.3.11		Ohaus balance	0234	2020-03-17	2021-03-17
Caliper 0511 2020-03-17 2021-03-2	Load/Strain properties	post-WA	7.3.4	D751	Instron 5969	0595	2020-04-01	2021-04-30
Dimensional change with loading	Dimensional change without loading	ng	7.3.12		Fischer Scientific oven	0212	2020-03-17	2021-03-17
Caliper 0511 2020-03-17 2021-03-2 Cone penetration 7.3.14 Instron 5969 0595 2020-04-01 2021-04-3 Heat Aging (HA) 60 days, 80°C 7.3.7 Fischer Scientific oven 0212 2020-03-17 2021-03-2 Load/Strain properties post-HA 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-03-3 Low temperature flexibility -40°C post-HA 7.3.8 D2136 So Low freezer 0604 2020-03-17 2021-03-3 NEMO 1-in. mandrel 0626 Accelerated Weathering 1 (AW1) 5000 hrs 7.3.7 D2565 Xenon Arc Lamp 0599 2019-02-02 2023-02-0 Load/Strain properties post-AW1 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-04-3 Low temperature impact -20°C post-AW1 7.3.6 D1790 SPI impact tester 0625 Verified Verified Accelerated Weathering 2 (AW2) 5000 hrs 7.3.7 G53, G154 QUV-SE 0596 Load/Strain properties post-AW2 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-03-3 Nemo 1-in. mandrel 0626 Verified Verified Accelerated Weathering 2 (AW2) 5000 hrs 7.3.7 G53, G154 QUV-SE 0596 Load/Strain properties post-AW2 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-04-3 Low temperature impact -20°C post-AW2 7.3.6 D1790 SPI impact tester 0625 Verified Verified Accelerated Weathering 2 (AW2) 5000 hrs 7.3.7 G53, G154 QUV-SE 0596 Load/Strain properties 0526 2020-03-17 2021-03-2 Low temperature impact -20°C post-AW2 7.3.6 D1790 SPI impact tester 0625 Verified Verified Accelerated Weathering 2 (AW2) 5000 hrs 7.3.6 D1790 SPI impact tester 0625 Verified Verified Veritas balance 0526 2020-03-17 2021-03-2 Veritas balance 0526 2020-03-17 2021-03-2 Low temperature flexibility -40°C post-AW2 7.3.8 D2136 So Low freezer 0604 2020-03-17 2021-03-2					Caliper	0511	2020-03-17	2021-03-17
Cone penetration 7.3.14 Instron 5969 0595 2020-04-01 2021-04-3 Heat Aging (HA) 60 days, 80°C 7.3.7 Fischer Scientific oven 0212 2020-03-17 2021-03-1 Load/Strain properties post-HA 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-4-3 Low temperature flexibility -40°C post-HA 7.3.8 D2136 So Low freezer 0604 2020-03-17 2021-03-1 NEMO 1-in. mandrel 0626 Accelerated Weathering 1 (AW1) 5000 hrs 7.3.7 D2565 Xenon Arc Lamp 0599 2019-02-02 2023-02-0 Load/Strain properties post-AW1 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-04-3 Low temperature impact -20°C post-AW1 7.3.6 D1790 SPI impact tester 0625 Verified Verified Veritas balance 0526 2020-03-17 2021-03-1 Nemo 1-in. mandrel 0626 Verified Verified Accelerated Weathering 2 (AW2) 5000 hrs 7.3.7 G53, G154 QUV-SE 0596 Load/Strain properties post-AW2 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-04-3 Low temperature impact -20°C post-AW2 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-03-1 Low temperature impact -20°C post-AW2 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-04-3 Low temperature impact -20°C post-AW2 7.3.6 D1790 SPI impact tester 0625 Verified Verified Veritas balance 0526 2020-03-17 2021-03-1 Low temperature impact -20°C post-AW2 7.3.6 D1790 SPI impact tester 0625 Verified Verified Veritas balance 0526 2020-03-17 2021-03-1 Low temperature flexibility -40°C post-AW2 7.3.8 D2136 So Low freezer 0604 2020-03-17 2021-03-1	Dimensional change with loading	7.3.13		Fischer Scientific oven	0212	2020-03-17	2021-03-17	
Heat Aging (HA)					Caliper	0511	2020-03-17	2021-03-17
Doad/Strain properties	Cone penetration		7.3.14		Instron 5969	0595	2020-04-01	2021-04-30
Description Text	Heat Aging (HA) 6	0 days, 80°C	7.3.7		Fischer Scientific oven	0212	2020-03-17	2021-03-17
NEMO 1-in. mandrel 0626	Load/Strain properties	post-HA	7.3.4	D751	Instron 5969	0595	2020-04-01	2021-4-30
Accelerated Weathering 1 (AW1) 5000 hrs 7.3.7 D2565 Xenon Arc Lamp 0599 2019-02-02 2023-02-04-01 2021-04-3	Low temperature flexibility -40°C	post-HA	7.3.8	D2136	So Low freezer	0604	2020-03-17	2021-03-17
Dodd/Strain properties					NEMO 1-in. mandrel	0626	-	-
Table Tabl	Accelerated Weathering 1 (AW1)	5000 hrs	7.3.7	D2565	Xenon Arc Lamp	0599	2019-02-02	2023-02-02
Veritas balance Veritas balance O526 2020-03-17 2021-03-17	Load/Strain properties	post-AW1	7.3.4	D751	Instron 5969	0595	2020-04-01	2021-04-30
Table Tabl	Low temperature impact -20°C	post-AW1	7.3.6	D1790	SPI impact tester	0625	Verified	Verified
Nemo 1-in. mandrel O626 Verified Verified					Veritas balance	0526	2020-03-17	2021-03-17
Accelerated Weathering 2 (AW2) 5000 hrs Load/Strain properties post-AW2 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-04-50 0595 2020-04-01 2021-04-50 0595 0595 0595 0595 0595 0595 0595 0	Low temperature flexibility -40°C	post-AW1	7.3.8	D2136	So Low freezer	0604	2020-03-17	2021-03-17
Load/Strain properties post-AW2 7.3.4 D751 Instron 5969 0595 2020-04-01 2021-04-32 Low temperature impact -20°C post-AW2 7.3.6 D1790 SPI impact tester 0625 Verified Verified Veritas balance 0526 2020-03-17 2021-03-17 Low temperature flexibility -40°C post-AW2 7.3.8 D2136 So Low freezer 0604 2020-03-17 2021-03-17					Nemo 1-in. mandrel	0626	Verified	Verified
Low temperature impact -20°C post-AW2 7.3.6 D1790 SPI impact tester 0625 Verified Verified Verified Verified Veritas balance 0526 2020-03-17 2021-03-12 University Control of the Control of Control o	Accelerated Weathering 2 (AW2)	5000 hrs	7.3.7	G53, G154	QUV-SE	0596	_	_
Veritas balance 0526 2020-03-17 2021-03-17 Low temperature flexibility -40°C post-AW2 7.3.8 D2136 So Low freezer 0604 2020-03-17 2021-03-17	Load/Strain properties	post-AW2	7.3.4	D751	Instron 5969	0595	2020-04-01	2021-04-30
Low temperature flexibility -40°C post-AW2 7.3.8 D2136 So Low freezer 0526 2020-03-17 2021-03-17	Low temperature impact -20°C	post-AW2	7.3.6	D1790	SPI impact tester	0625	Verified	Verified
·	· ·	•			Veritas balance	0526	2020-03-17	2021-03-1
·	Low temperature flexibility -40°C	post-AW2	7.3.8	D2136	So Low freezer	0604		
	· · · · · · · · · · · · · · · · · · ·	•	_		NEMO 1-in. mandrel	0626	Verified	Verified