KARLVILLE

Date: January 21st, 2020
Author: Razvan Stelea

Indigo
Pack Ready

Validation Report: Cosmo Gloss BOPP EVA

Karlville
3600 NW 59th
Street Miami, FL,
33142

Phone: +1.305.533.1051
Fax: +1.305.517.1172
Email: info@karlville.com
Web: www.karlville.com

Subject: Pack Ready validation test report for COSMO (film supplier) / KARLVILLE trial

Date January 21,2020

(Supplier & Product) : COSMO BOPP 25.5um - SUBMITTED FOR EVALUATION

Requirements:

1. **Roll Details:**
In Table 1 list number of rolls, size of rolls and details of all thermal lamination films including product codes, corona treatment, additives (if applicable) etc…
2. **SAMPLES to be sent toIsrael:**
   a. 70m (230ft.) of laminated material (see test protocol supplied by HP-Indigo R&D)
   b. Pouching: Karlville to send pouches of the laminated film – **N/A**

Procedure:

Roll Details and condition: Each of the produced rolls underwent an incoming inspection and tested for:

- Visual inspection: Record general condition and/or any defects (coating quality, visual defects) & Curling
- Constructions: Each construction shall be listed along with all pertinent details captured in Table 2

Production /summary: Run lamination test based on test protocol supplied by HP R&D. fill Table 3 for process parameters.

- LBS testing: Each construction will be subject to Lamination Bond Strength (LBS) measurements as indicated in the test protocol. LBS measurements will be performed as follows:
  - Immediately after the lamination (to be performed by Karlville)
  - 24 hours after the lamination (to be performed by Karlville)
  - 2-4 weeks after the lamination (to be performed in parallel by Karlville & HP-Indigo R&D @ Israel)

Table 1 – Roll details:

Product code	Material	Resin EMA or EVA	Thickness [µm]	Roll width [mm]	Corona treatment [Y/N]	Additives
25.5 PCT-2(DL)	HS BOPP THERMAL GLOSS	EVA	25.5	750	YES	N/A

Table 2 - Production summary & experimental details:

EXP. #	Printed substrate	Surface / reverse print	TAP substrate	TAP on top or 2'nd	Total Thickness [µm]
RS-010	BOPP 25.5um	SURFACE	COSMO BOPP THERMAL HS GLOSS	TOP	51

Table 3 - Process parameters:

EXP. #	Nip temperature [°C]	Lamination speed [m/min]	Corona on TAP [W]	Corona on print [W]	Wrapping angle [deg.]	Tension print [kg]	Tension tap [kg]	Tension RW [kg]	Tension infeed [kg]	Pressure [Bar] L/R	Pre-Heat [°C]
RS-010	115	50	2.0	2.0	75	8.0	2.0	10.0	8.0	.5 / .5	50

1. Pre-lamination – film inspection remarks:

- Curling score (in cm TD and MD): Good
- Thermal active layer coating quality: Good
- Visual defects: N/A
- Comments:

2. Post lamination results:

Exp. #	Composition		AVG. LBS [N/in] (Failure mode*)						Visual appearance (Y/N)		
			Left side of hot drum OS			Right side of hot drum GS					
			Patch 22	Patch 16	Patch 11	Patch 22	Patch 16	Patch 11	Curling	Wrinkles	Pinching
RS-010	MET-BOPP HS / INK / BOPP	t=0	6.4	6.3	TEAR	7.8	7.4	TEAR	N/A	N/A	N/A
		t=24	5.9	6.1	TEAR	7.4	8.4	TEAR			

* The abbreviations of the failure modes stand for the following:

NT – No transfer of ink from the printed substrate to laminated substrate

TT – Total transfer of ink from the printed substrate to laminated substrate

PT – Partial Transfer of ink from the printed substrate (write the percentage of ink remaining on the printed substrate)

PTT – Partial TAP transfer from the Pack Ready film

TTT – Total TAP Transfer from the Pack Ready film to the printed substrate

3. Sealing bond strength results:

			Dwell time [sec]	SBS [N/in]				
				120C	130C	140C	150C	160C
RS-010	BOPP GLOSS/INK/HS BOPP	HS-BOPP	0.5	DL	DL	DL	DL	1.4
			1	DL	DL	DL	4.7	4.7
			0.5					
			1					

4. Sealed are appearance:

			Dwell time [sec]	SBS [N/in]				
				120C	130C	140C	150C	160C
RS-010	BOPP GLOSS/INK/HS BOPP	HS-BOPP	0.5					
			1					

Color code reflects property rating: Red = Bad Yellow = Moderate Green = Good

COF Test will be done for each laminated sample, and comparison to the non-laminated thermal film

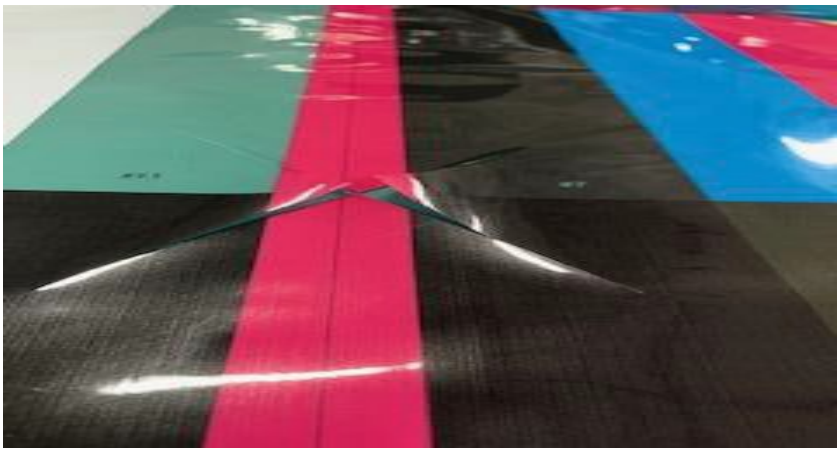
- In HFFS (horizontal form fills and seal) systems, too much friction of the sealant side of the film can lead to film dragging or jamming as it passes over metal plates.
- In VFFS (vertical form fills and seal) systems, too much friction of the sealant side of the film can cause poor film feeding over metal forming collars, inconsistent package sizes, and squealing.

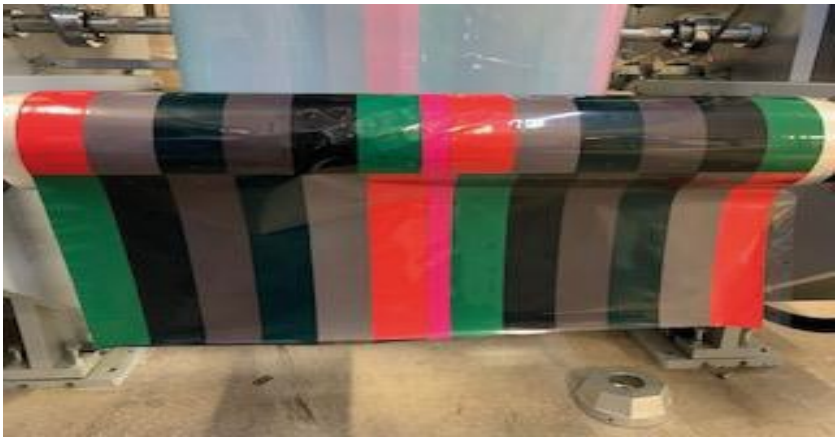
COF TESTS CRITERIA

FFS	Pass	Fail
VFFS	0.2 – 0.4	COF <0.2 or >0.4
HFFS	TBD	TBD

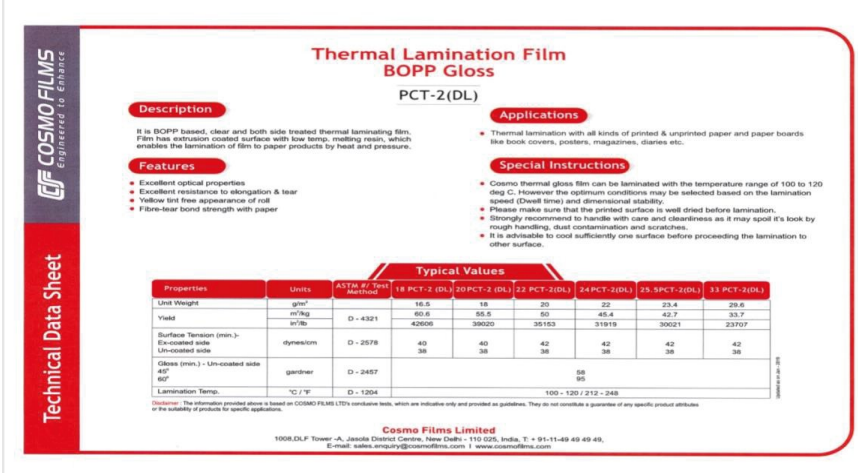
EXP #: RS-010		Inside to inside (seal)	Out to Out (print)
Laminated construction : COSMO 25.5 um HS BOPP/BOPP 25.5um HS BOPP SURFACE PRINTED	#1	0.36	0.18
	#2	0.41	0.23
	#3	0.41	0.36
	#4	0.18	0.27
	AVG	0.34	0.26
	STD	0.11	0.08
TEST ON NON-LAMINATED FILM WILL BE DONE ON EMPTY SIDE			
Non-Laminated thermal film: COSMO HS 25.5 BOPP	#1		0.27
	#2		0.18
	#3		0.27
	#4		0.18
	AVG		0.23
	STD		0.05

Curling post lamination 5mm in TD direction





COSMO THERMAL BOPP - TDS



COSMO FILMS
Engineered to Enhance

Technical Data Sheet

Thermal Lamination Film
BOPP Gloss

PCT-2(DL)

Description

It is BOPP based, clear and both side treated thermal laminating film. Film has extrusion coated surface with low temp. melting resin, which enables the lamination of film to paper products by heat and pressure.

Features

- Excellent optical properties
- Excellent resistance to elongation & tear
- Yellow tint free appearance of roll
- Fibre-tear bond strength with paper

Applications

- Thermal lamination with all kinds of printed & unprinted paper and paper boards like book covers, posters, magazines, diaries etc.

Special Instructions

- Cosmo thermal gloss film can be laminated with the temperature range of 100 to 120 deg C. However the optimum conditions may be selected based on the lamination speed (Dwell time) and dimensional stability.
- Please make sure that the printed surface is well dried before lamination.
- Strongly recommend to handle with care and cleanliness as it may spoil it's look by rough handling, dust contamination and scratches.
- It is advisable to cool sufficiently one surface before proceeding the lamination to other surface.

Typical Values

Properties	Units	ASTM #/ Test Method	18 PCT-2 (DL)	20 PCT-2 (DL)	22 PCT-2(DL)	24 PCT-2(DL)	25.5 PCT-2(DL)	33 PCT-2(DL)
Unit Weight	g/m²		16.5	18	20	22	23.4	29.6
Yield	m²/kg	D - 4321	60.6	55.5	50	45.4	42.7	33.7
	m²/lb		42606	39020	35153	31919	30021	23707
Surface Tension (min.):- Ex-coated side Un-coated side	dynes/cm	D - 2578	40 38	40 38	42 38	42 38	42 38	42 38
Gloss (min.) - Un-coated side 45° 60°	gardner	D - 2457	58 95					
Lamination Temp.	°C / °F	D - 1204	100 - 120 / 212 - 248					

Disclaimer : The information provided above is based on COSMO FILMS LTD's conclusive tests, which are indicative only and provided as guidelines. They do not constitute a guarantee of any specific product attributes or the suitability of products for specific applications.

Cosmo Films Limited
1008,DLF Tower -A, Jasola District Centre, New Delhi - 110 025, India, T: + 91-11-49 49 49 49,
E-mail: sales.enquiry@cosmofilms.com I www.cosmofilms.com

SURFACE PRINTED HS BOPP - TDS

Bicor™ 100 BSR-ONE

Jindal Films

Product Description

Bicor BSR-ONE is a two-side sealable, one-side treated, coextruded OPP film designed for unsupported plain or surface print applications, and in laminations on both HFFS and VFFS packaging machines. As Bicor BSR-ONE is two-side sealable, it can be used for lap or fin seal and box overwrap applications.

Key Features

- Excellent machinability
- Stable COF
- Excellent hot tack
- Excellent hot slip & hot jaw release
- Excellent heat seal strength
- Wide heat seal range on the untreated side (80°F/45°C)
- Non-migratory slip system for consistent COF

General

Availability

- Latin America
- North America
- South America

Features

- In Lamination Lap Sealable

Applications

- Biscuits/Cookie/Crackers
- Box Overwrap
- Confectionery, Gum
- Confectionery, Sugar
- Bakery
- Frozen Food
- Crisps and Snacks
- Pet Food

Uses

- Box Overwrap Flexible Packaging
- HFFS Flexible Packaging
- Pre-made Bags - Flexible Packaging
- VFFS Flexible Packaging

Appearance

- Clear/Transparent

Processing Method

- Inner Web Adhesive Lamination
- Outer Web Adhesive Lamination
- Solvent Flexographic Printing
- Solvent Rotogravure Printing
- Surface Print Unsupported

Properties

Property	Typical Value	Unit	Test Based On
Yield	30500	in²/lb	Internal Method
Unit Weight	14.2	lb/ream	Internal Method
Film Thickness	1.0	mil	Internal Method
Gloss(45°)			
Treated Surface	85		Internal Method
Haze	1.9	%	Internal Method
Tensile Strength at Break			
20 in/min pull rate, 2.0 in jaw separation			
MD	18000	psi	Internal Method
TD	35000	psi	Internal Method
Dimensional Stability 135°C / 275°F, 7 min			
MD	-5.0	%	Internal Method
TD	-4.5	%	Internal Method
Crimp Seal Strength			
250°F, 20 psi, 0.75 sec	450	g/in	Internal Method
Crimp Seal MST (Minimum Seal Temperature)			
Untreated/Untreated	214	°F	Internal Method
Treated/Treated	234	°F	Internal Method
Coefficient of Friction			
Treated/Treated	0.34		Internal Method
Untreated/Untreated	0.39		Internal Method
Wetting Tension			
Treated Surface	0.80	receding cos θ	Internal Method
Water Vapor Transmission Rate			
100°F, 90% RH	0.32	g/100 in²/24 hr	Internal Method

Legal Statement

Contact your Jindal Films Customer Service Representative for potential food contact application compliance (e.g. FDA, EU, HPFB). This product is not intended for use in medical applications and should not be used in any such applications.

Processing Statement

- BSR-ONE contains a non-migratory slip system. Do not retreat.
- Priming is generally required when running water-based inks and adhesives with BSR-ONE. Consult your Jindal Films Technical Service Representative or supplier.

Footnotes

1. Product may not be available in one or more countries in the identified Availability regions. Please contact your Sales Representative for complete country availability.
2. Tested at 38°C (100°F)/100%RH, then calculated to 90%RH with .90 multiplier.

Revision date

May 14, 2015

Typical properties: these are not to be construed as specifications.

Thermal film COF test results

MT-2500 Statistics

Test Date 22 Jan, 2020
Technician
Test Method
Product Name Color Order #
Sample Thickness 1.000 mil Sample Width 1.00 in Sample Length 5.00 in
Grip Separation 2.00 in
Film Direction
Crosshead Speed 6.000 (ipm)
Sample Conditioning

Test Conditions

THERMAL FILM OUT / OUT

Test Units	Static COF	Kinetic COF
Sample#		
1	0.27	0.27
2	0.18	0.18
3	0.27	0.30
4	0.18	0.19
Minimum	0.18	0.18
Maximum	0.27	0.30
Range	0.09	0.12
Average	0.23	0.23
Std. Dev.	0.05	0.06
Cpk		

Comments

Laminated film COF test results print to print /

MT-2500 Statistics

Test Date 22 Jan, 2020
Technician
Test Method
Product Name Color Order #
Sample Thickness 1.000 mil Sample Width 1.00 in Sample Length 5.00 in
Grip Separation 2.00 in
Film Direction
Crosshead Speed 6.000 (ipm)
Sample Conditioning

Test Conditions

OUT TO OUT PRINT

Test	Static COF	Kinetic COF
Units		
Sample#		
1	0.18	0.23
2	0.23	0.22
3	0.36	0.33
4	0.27	0.25
Minimum	0.18	0.22
Maximum	0.36	0.33
Range	0.18	0.12
Average	0.26	0.26
Std. Dev.	0.08	0.05
Cpk		

Comments

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Laminated film COF test results seal to seal / in to in

MT-2500 Statistics

Test Date 22 Jan, 2020
Technician
Test Method
Product Name Color Order #
Sample Thickness 1.000 mil Sample Width 1.00 in Sample Length 5.00 in
Grip Separation 2.00 in
Film Direction
Crosshead Speed 6.000 (ipm)
Sample Conditioning

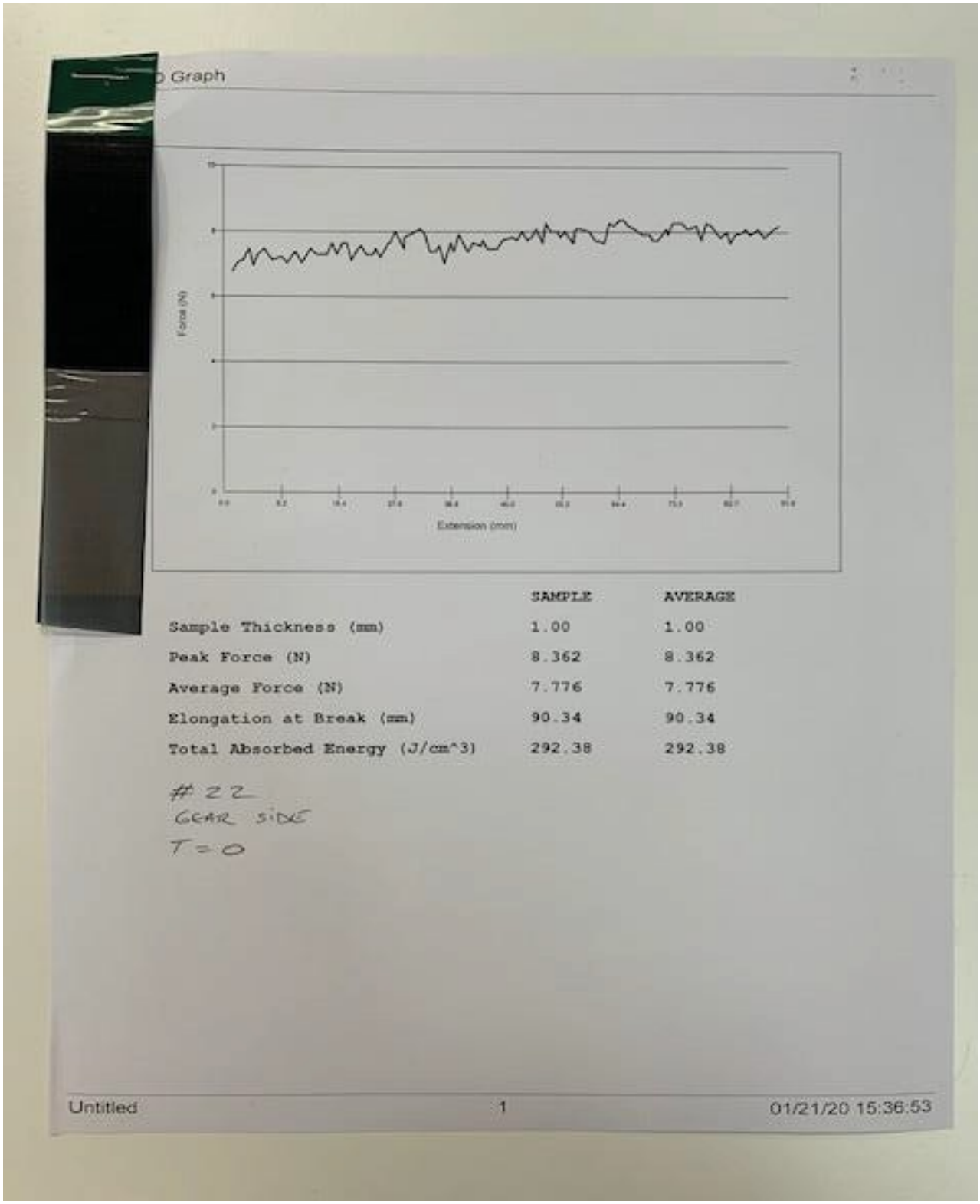
Test Conditions

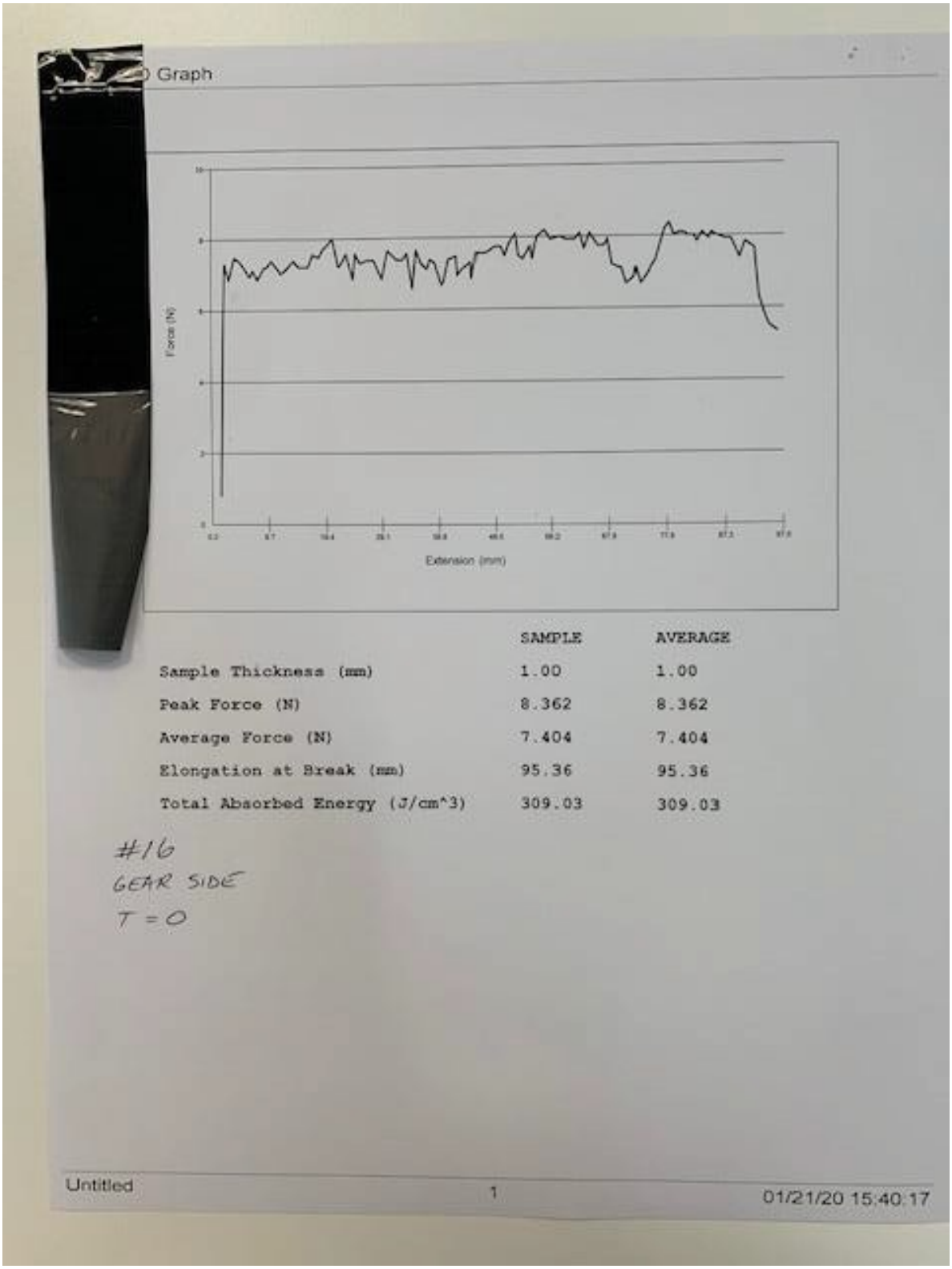
IN TO IN (SEAL)

Test / Units	Static COF	Kinetic COF
Sample# 1	0.36	0.29
2	0.41	0.31
3	0.41	0.26
4	0.18	0.15
Minimum	0.18	0.15
Maximum	0.41	0.31
Range	0.23	0.16
Average	0.34	0.25
Std. Dev.	0.11	0.07
Cpk		

Comments

Post lamination LBS test results:




Graph
Force (N)
Extension (mm)
SAMPLE AVERAGE
Sample Thickness (mm) 1.00 1.00
Peak Force (N) 8.362 8.362
Average Force (N) 7.404 7.404
Elongation at Break (mm) 95.36 95.36
Total Absorbed Energy (J/cm^3) 309.03 309.03
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GEAR SIDE
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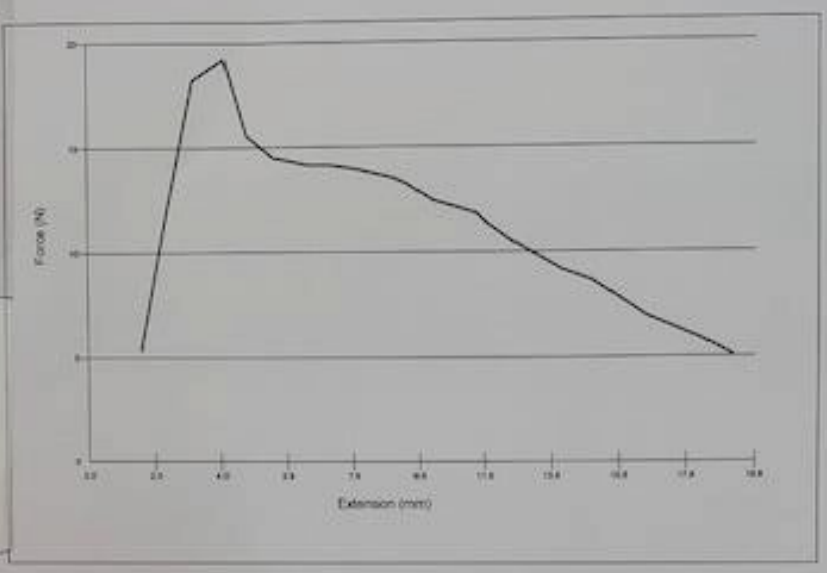
MT 2500 Graph



	SAMPLE	AVERAGE
Sample Thickness (mm)	1.00	1.00
Peak Force (N)	13.521	13.521
Average Force (N)	9.196	9.196
Elongation at Break (mm)	18.23	18.23
Total Absorbed Energy (J/cm^3)	92.62	92.62

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TEAR @ 9.2

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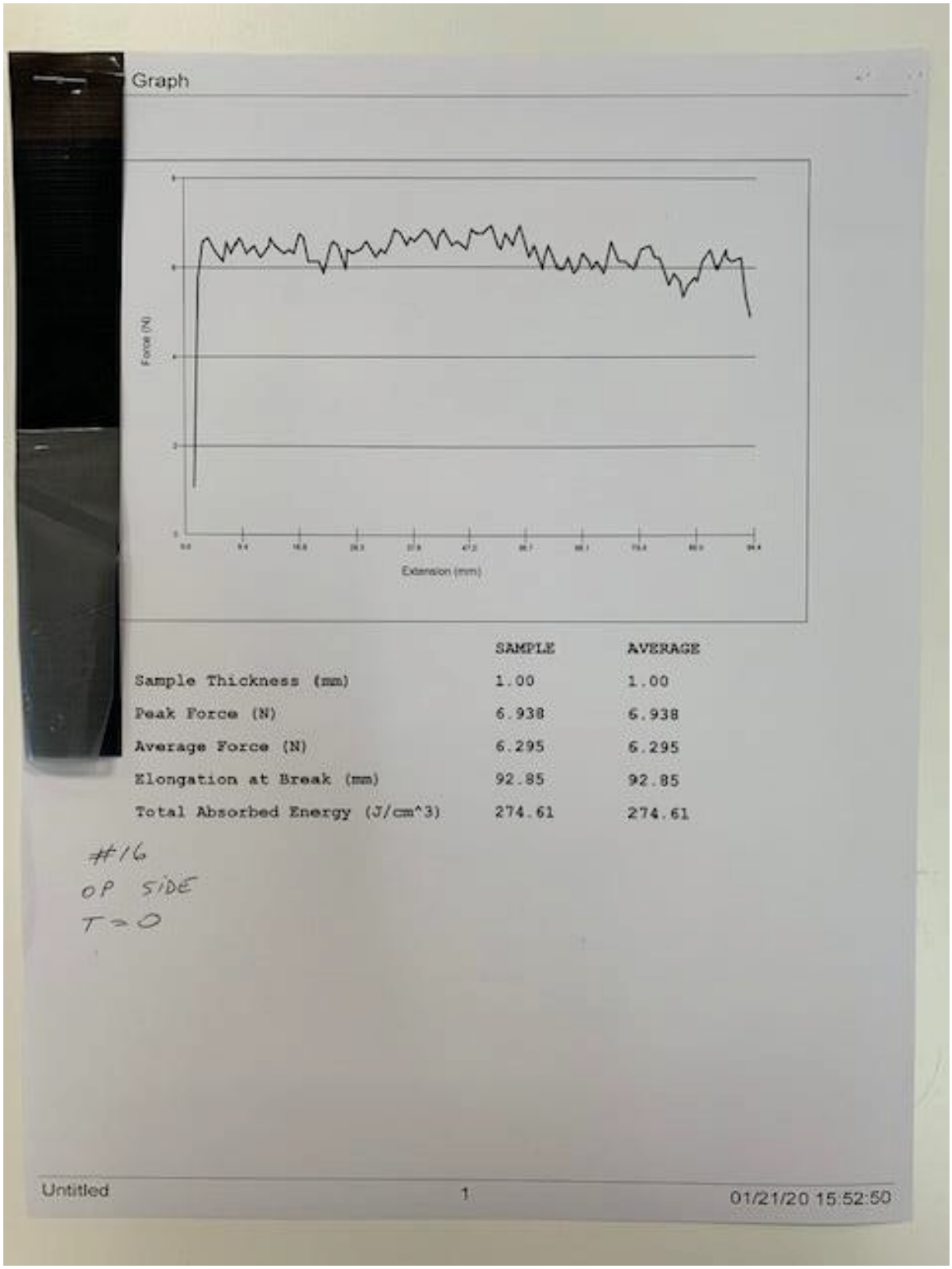

Graph

Force (N)

Extension (mm)

	SAMPLE	AVERAGE
Sample Thickness (mm)	1.00	1.00
Peak Force (N)	6.938	6.938
Average Force (N)	6.295	6.295
Elongation at Break (mm)	92.85	92.85
Total Absorbed Energy (J/cm^3)	274.61	274.61

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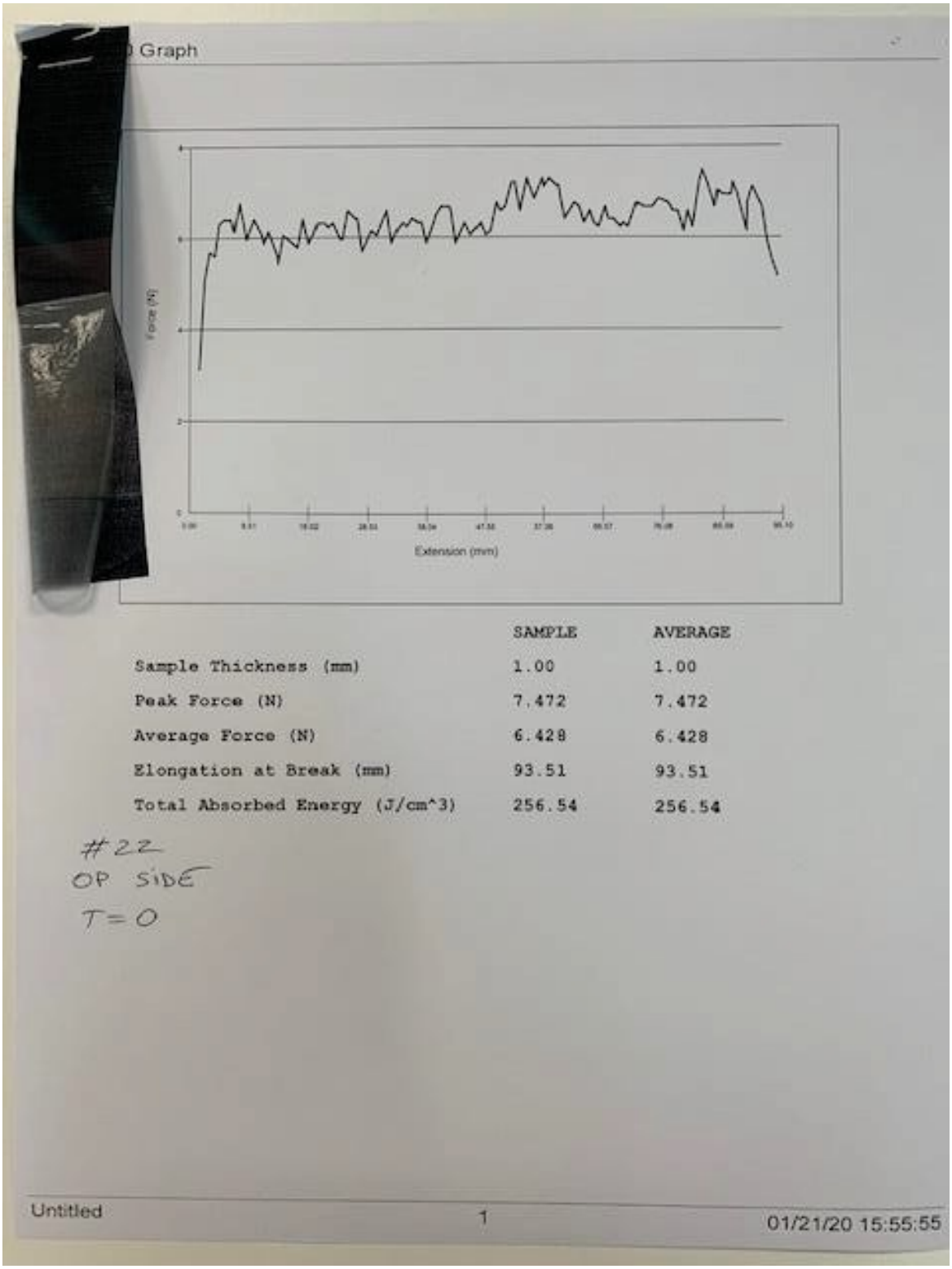
Graph
Force (N)
Extension (mm)
SAMPLE AVERAGE
Sample Thickness (mm) 1.00 1.00
Peak Force (N) 7.472 7.472
Average Force (N) 6.428 6.428
Elongation at Break (mm) 93.51 93.51
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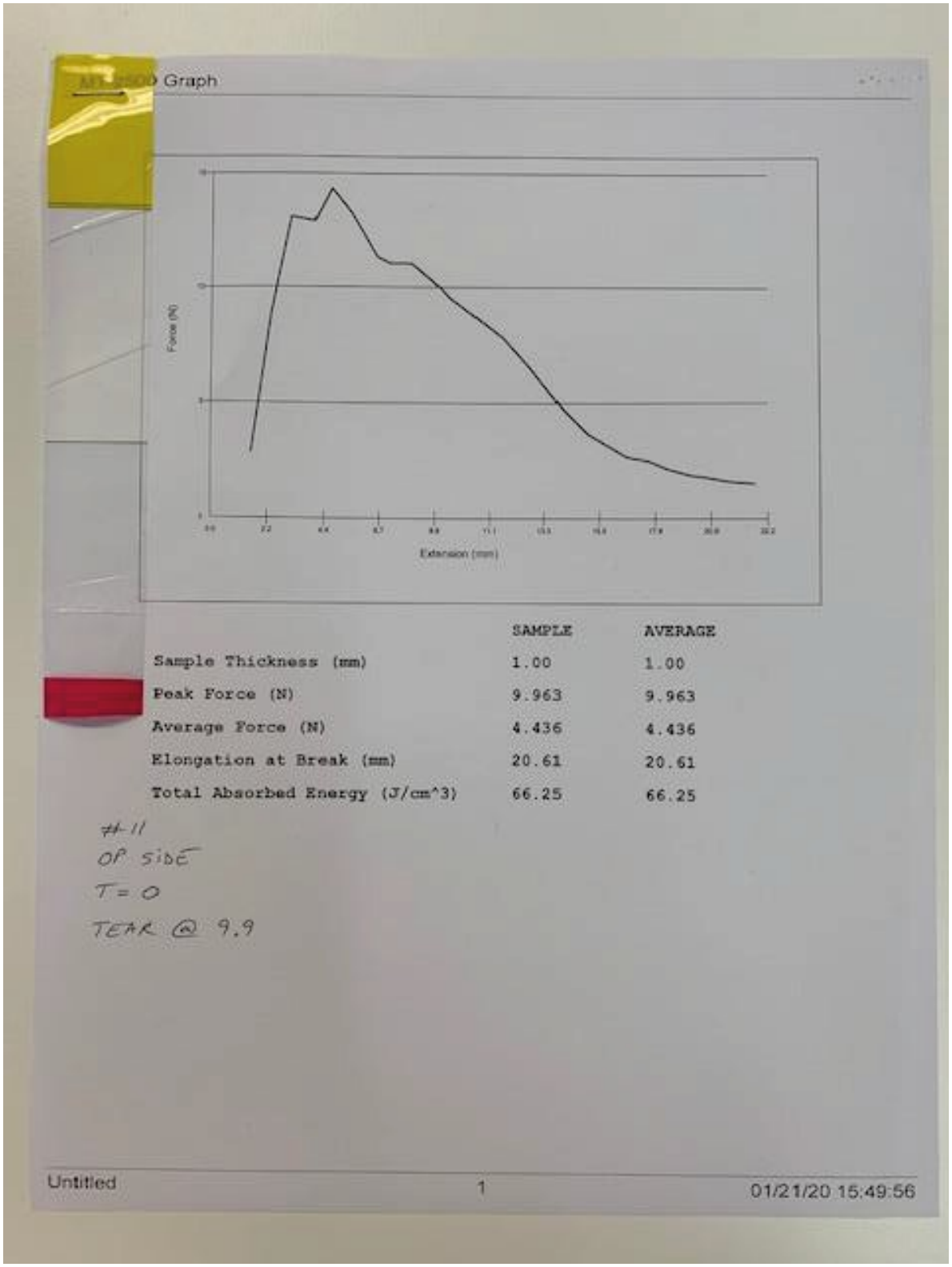

Graph

Force (N)

Extension (mm)

	SAMPLE	AVERAGE
Sample Thickness (mm)	1.00	1.00
Peak Force (N)	9.963	9.963
Average Force (N)	4.436	4.436
Elongation at Break (mm)	20.61	20.61
Total Absorbed Energy (J/cm^3)	66.25	66.25

#11
OP SIDE
T = 0
TEAR @ 9.9

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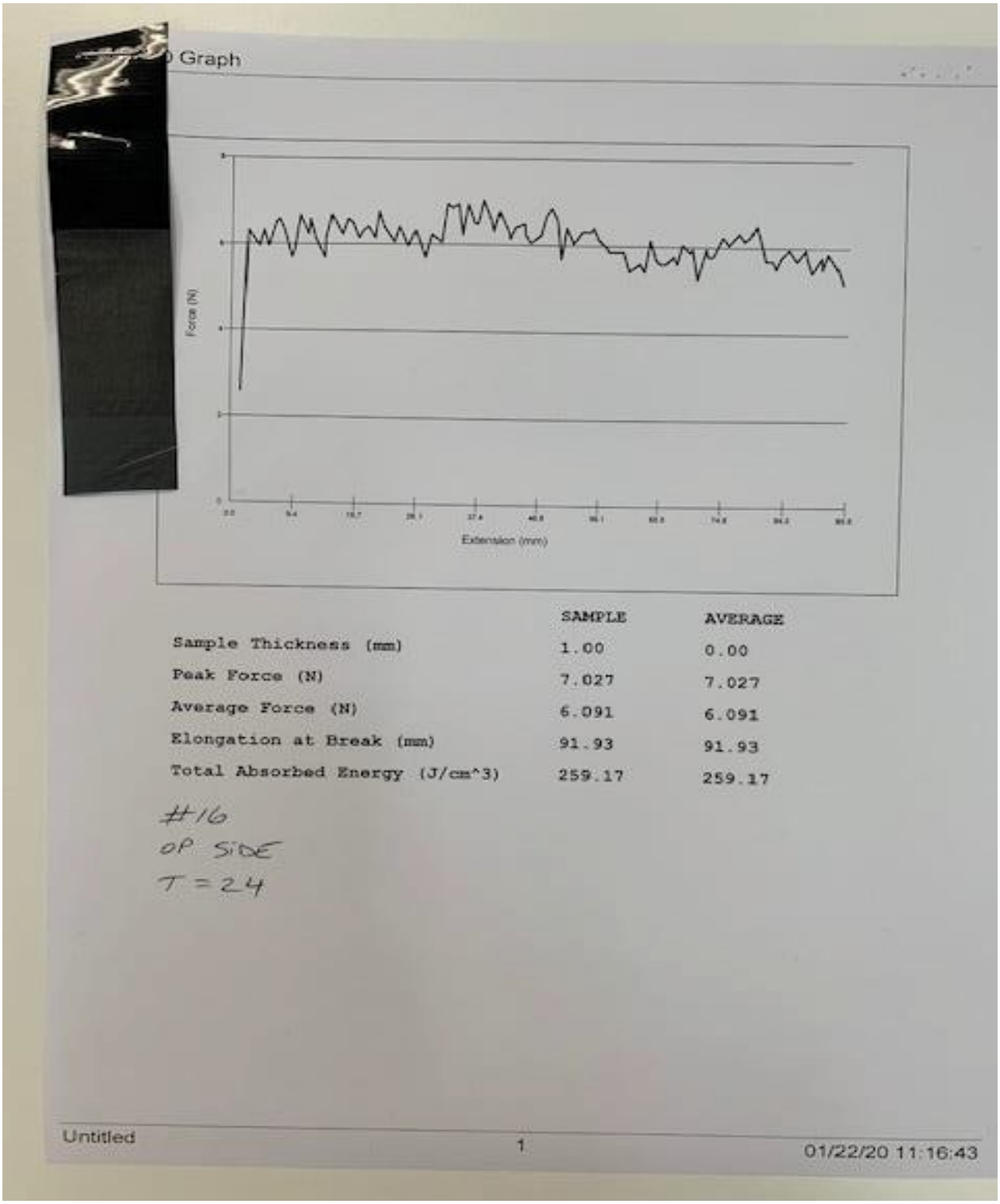
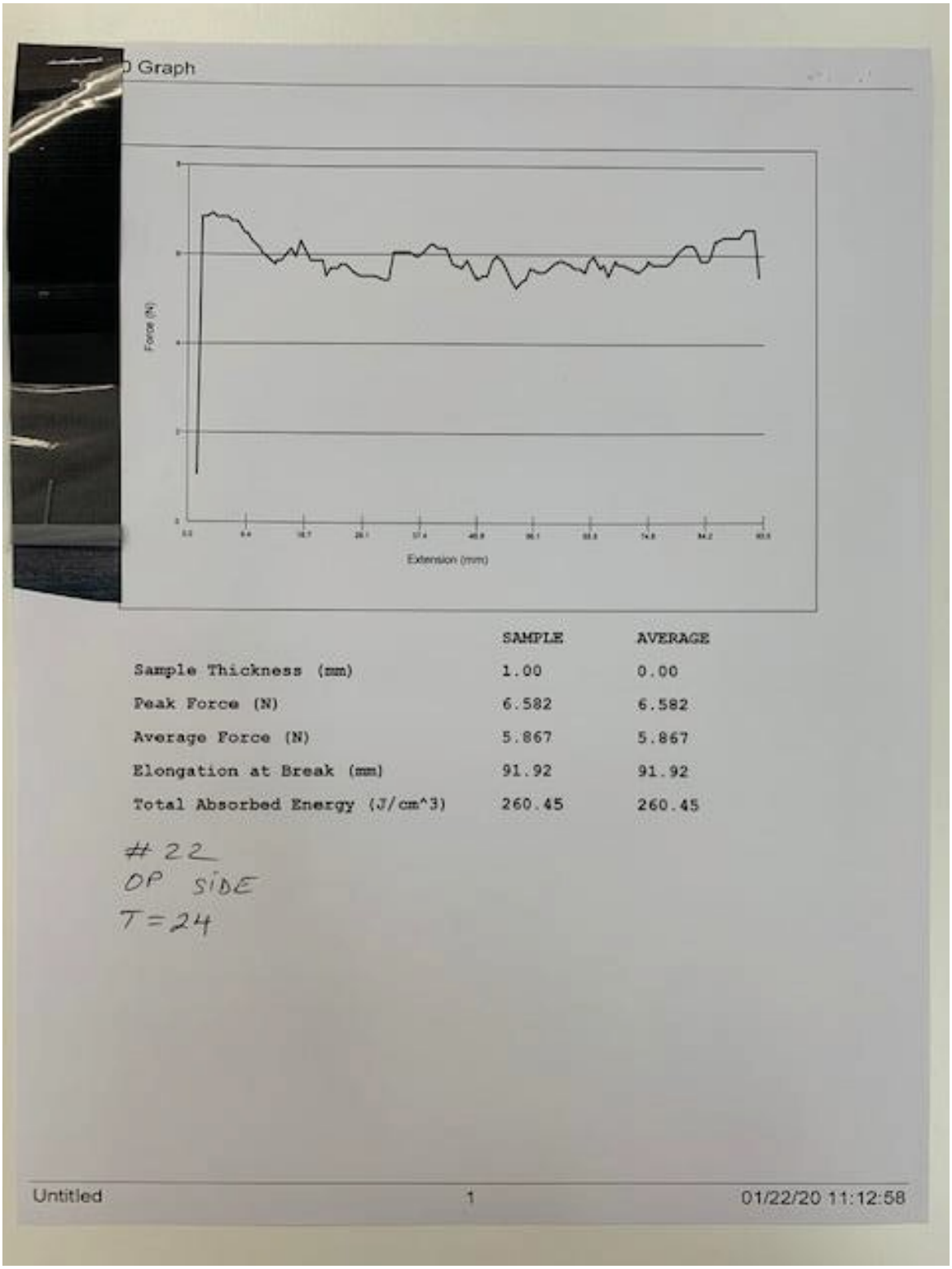
LBS test results 24 hours post lamination





Graph

	SAMPLE	AVERAGE
Sample Thickness (mm)	1.00	0.00
Peak Force (N)	6.582	6.582
Average Force (N)	5.867	5.867
Elongation at Break (mm)	91.92	91.92
Total Absorbed Energy (J/cm^3)	260.45	260.45

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OP SIDE
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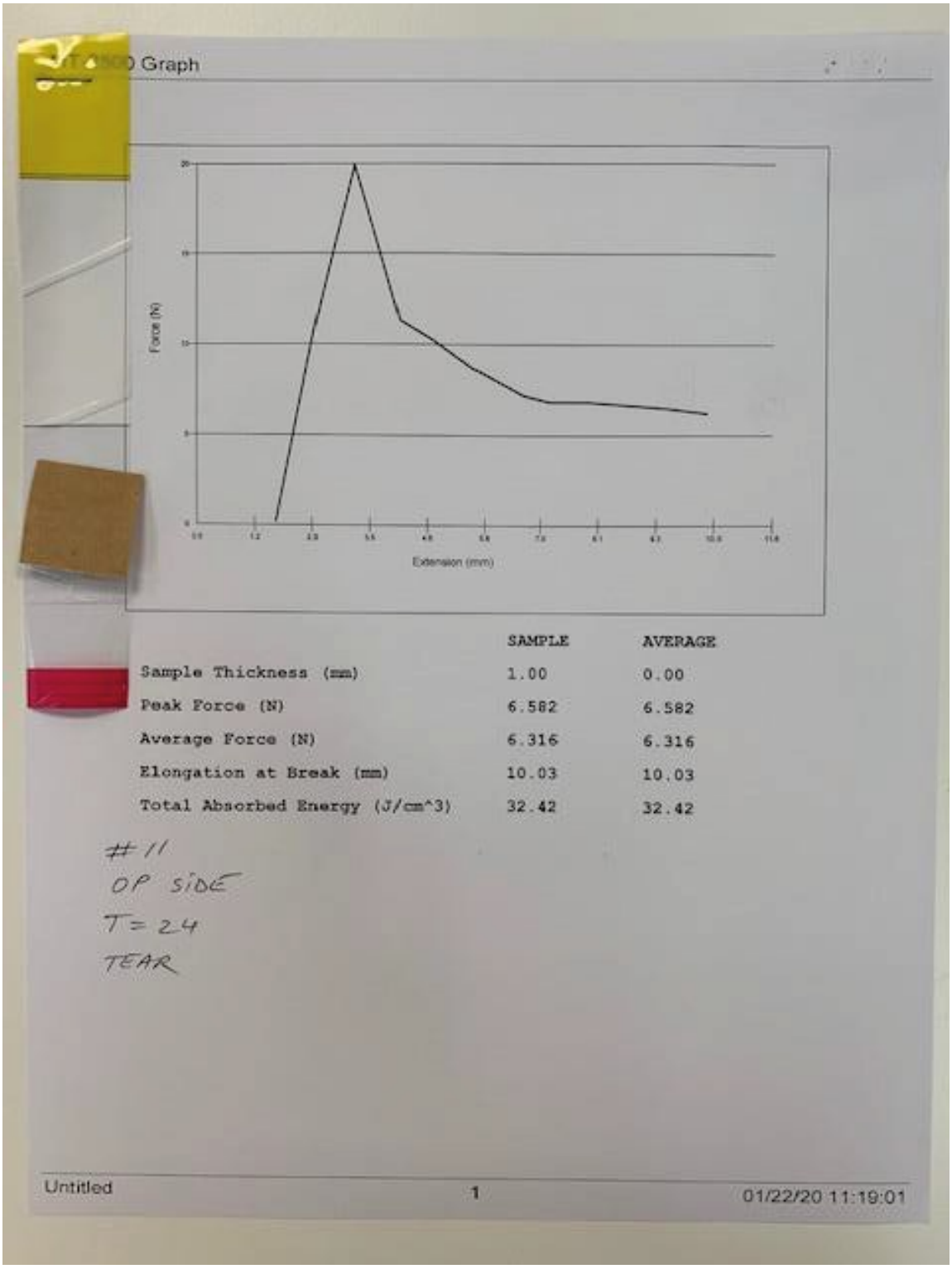
Graph
Force (N)
Extension (mm)
SAMPLE AVERAGE
Sample Thickness (mm) 1.00 0.00
Peak Force (N) 6.582 6.582
Average Force (N) 6.316 6.316
Elongation at Break (mm) 10.03 10.03
Total Absorbed Energy (J/cm^3) 32.42 32.42
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OP SIDE
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TEAR
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1
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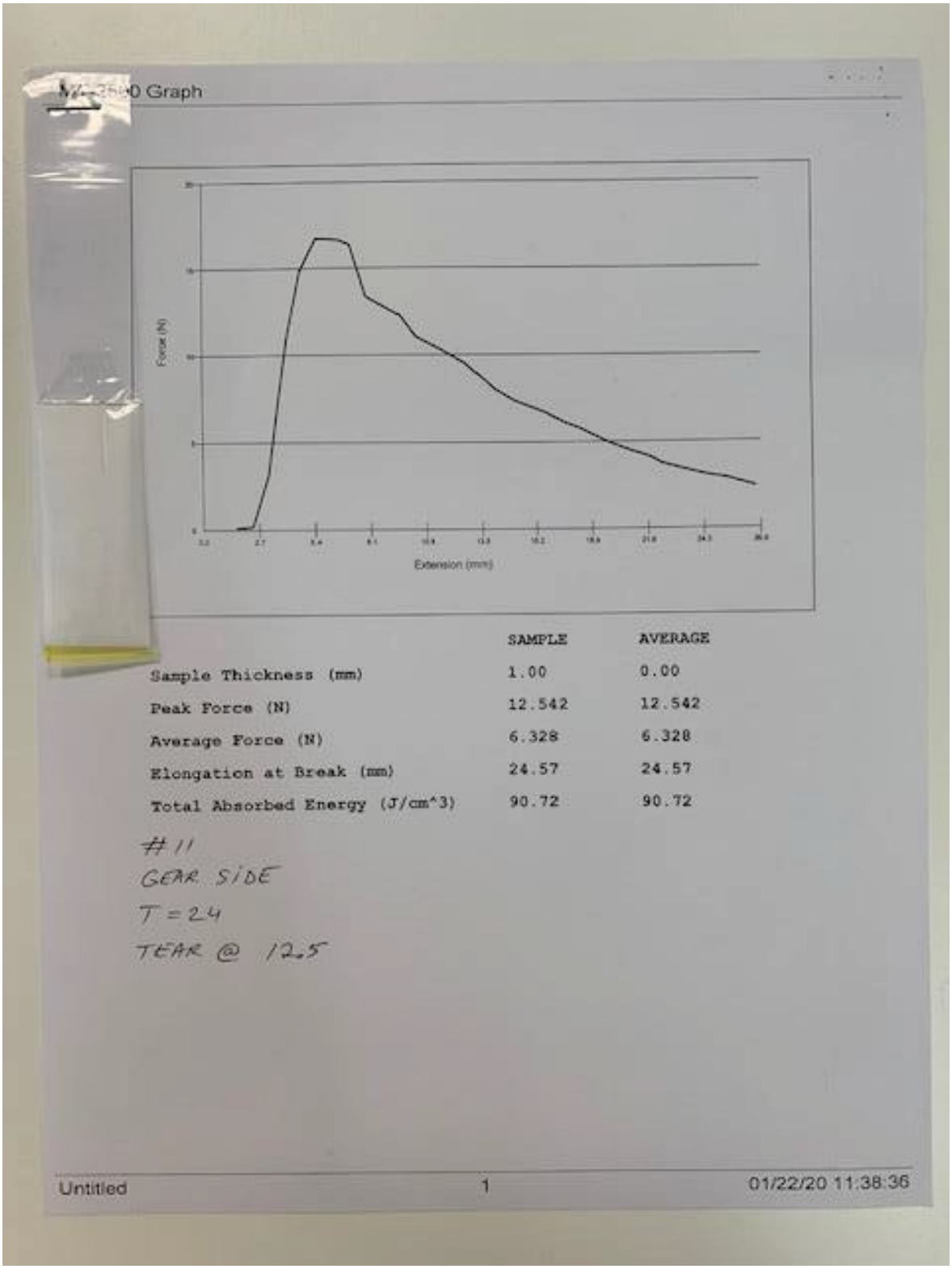

0 Graph

Force (N)

Extension (mm)

	SAMPLE	AVERAGE
Sample Thickness (mm)	1.00	0.00
Peak Force (N)	12.542	12.542
Average Force (N)	6.328	6.328
Elongation at Break (mm)	24.57	24.57
Total Absorbed Energy (J/cm^3)	90.72	90.72

#11
GEAR SIDE
T = 2.4
TEAR @ 12.5

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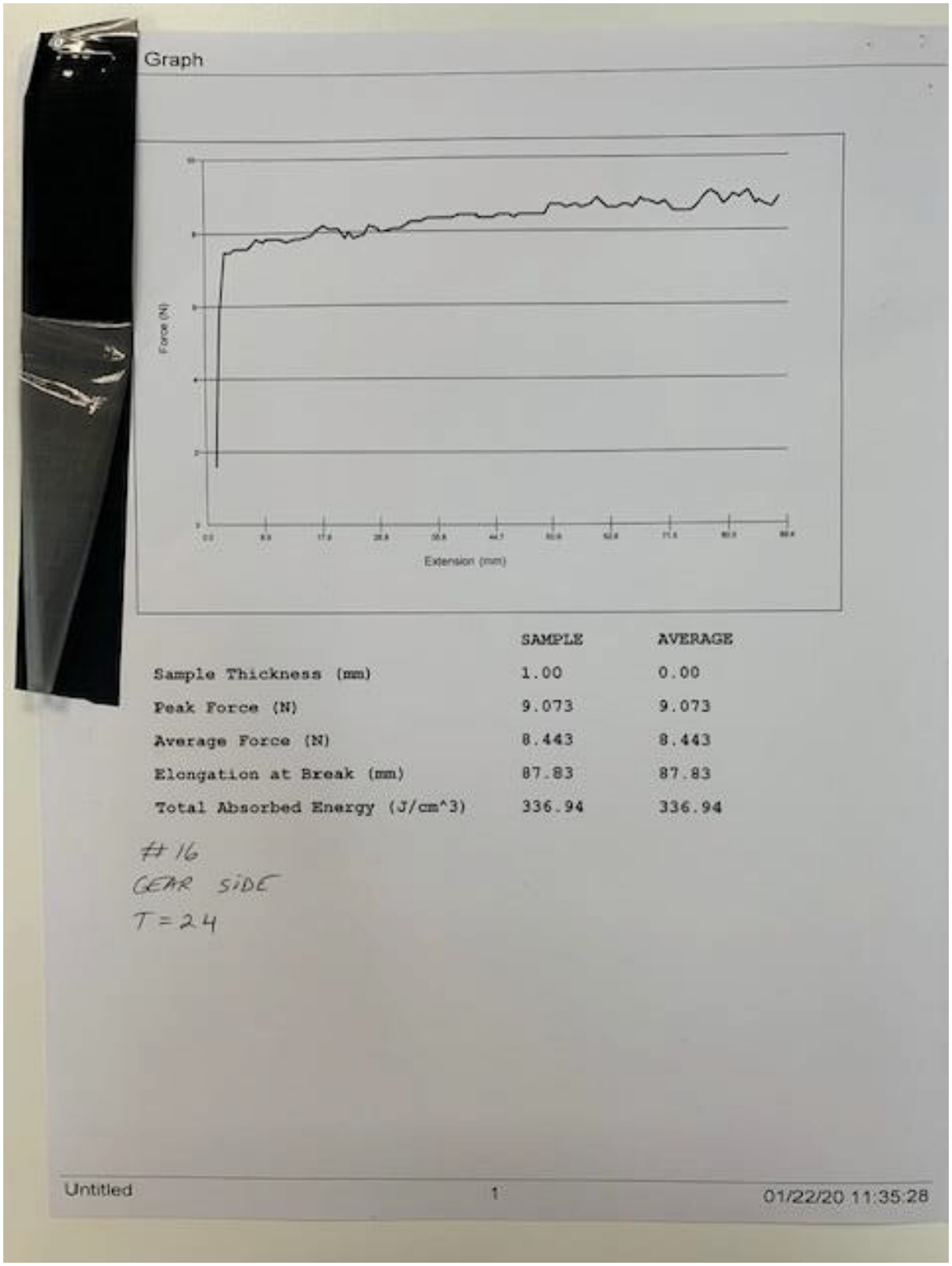
Graph
Force (N)
Extension (mm)
SAMPLE AVERAGE
Sample Thickness (mm) 1.00 0.00
Peak Force (N) 9.073 9.073
Average Force (N) 8.443 8.443
Elongation at Break (mm) 87.83 87.83
Total Absorbed Energy (J/cm^3) 336.94 336.94
#16
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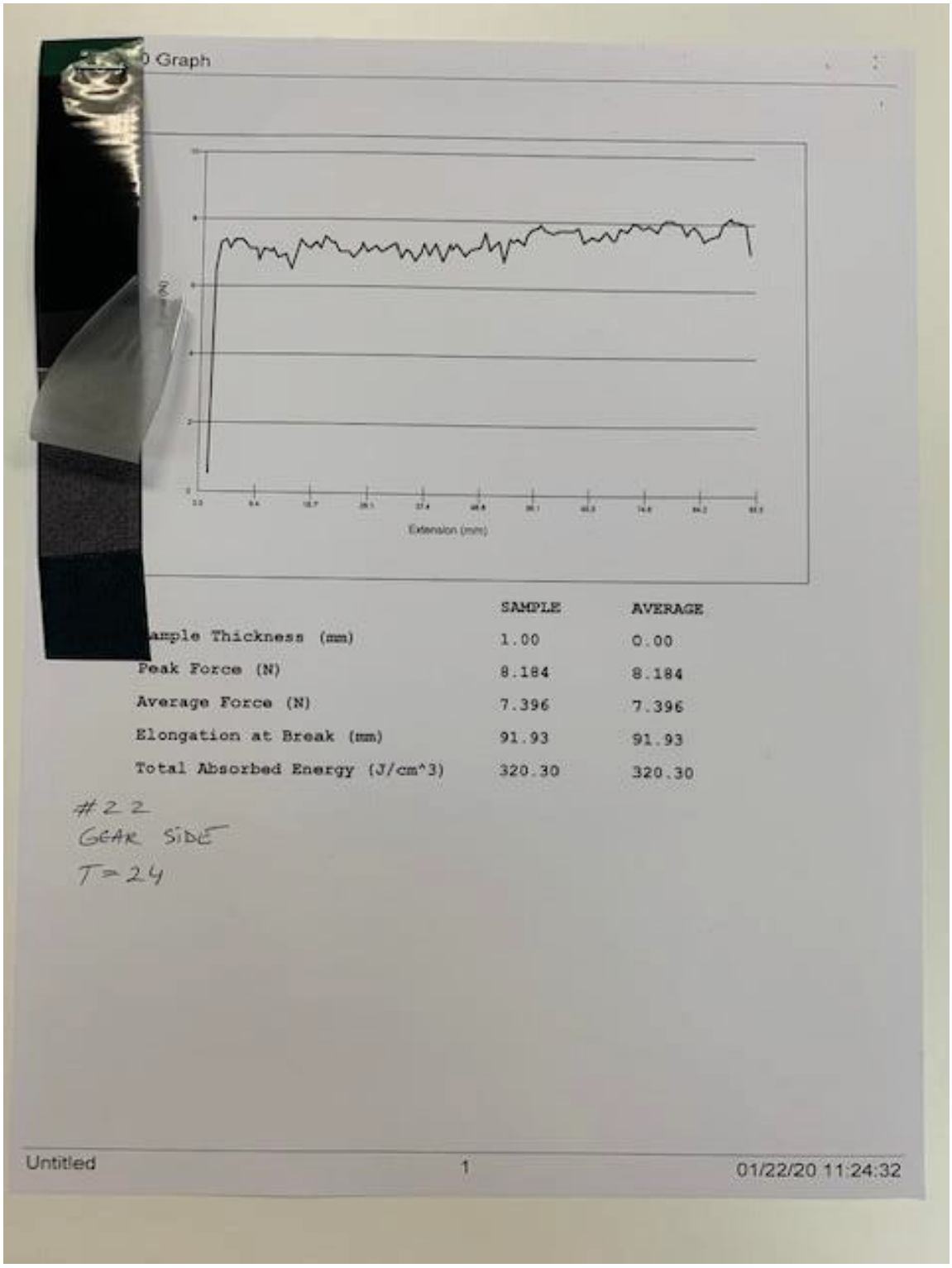
1
01/22/20 11:35:28


Graph
Extension (mm)
SAMPLE AVERAGE
ample Thickness (mm) 1.00 0.00
Peak Force (N) 8.184 8.184
Average Force (N) 7.396 7.396
Elongation at Break (mm) 91.93 91.93
Total Absorbed Energy (J/cm^3) 320.30 320.30
#22
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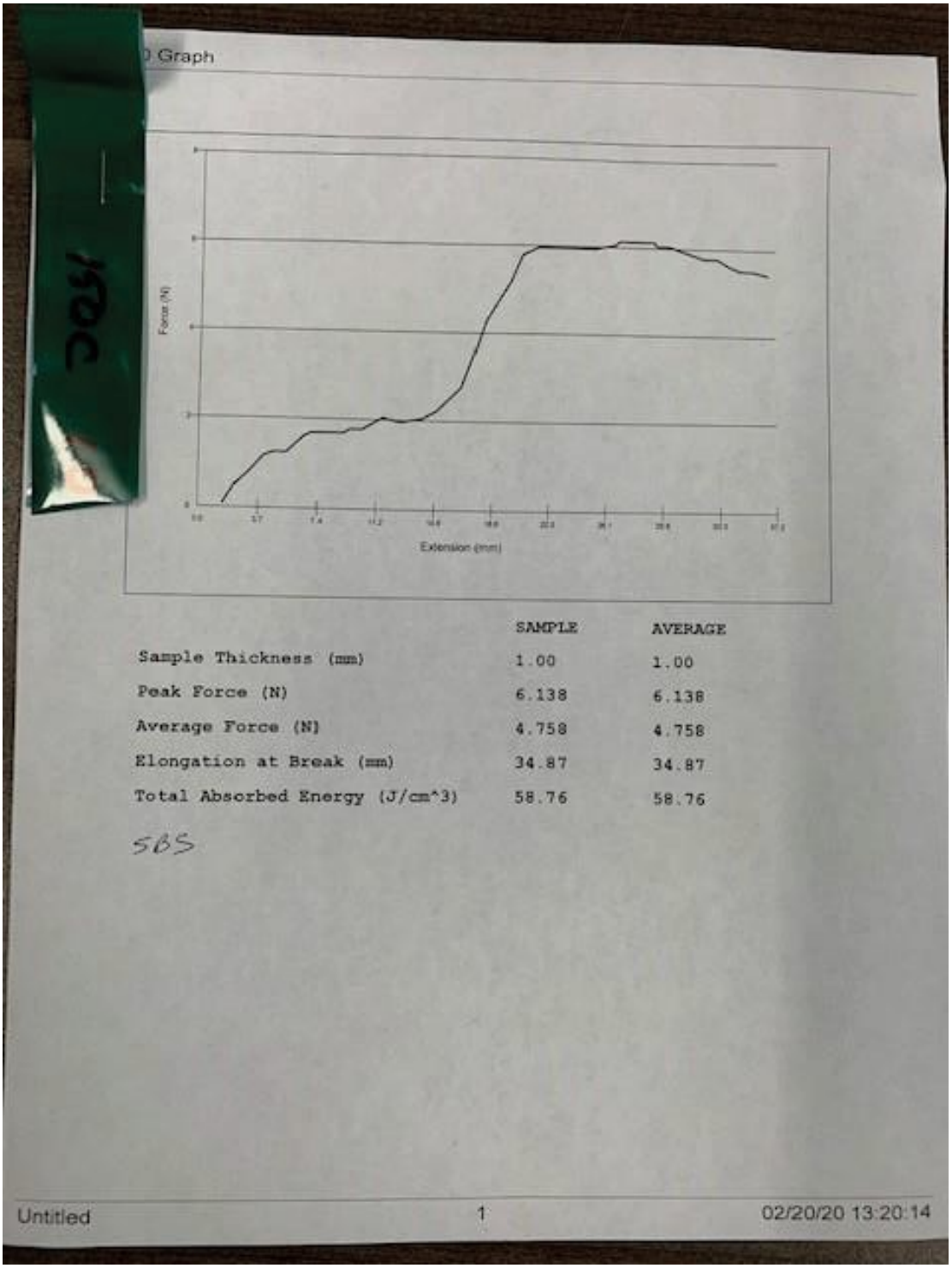
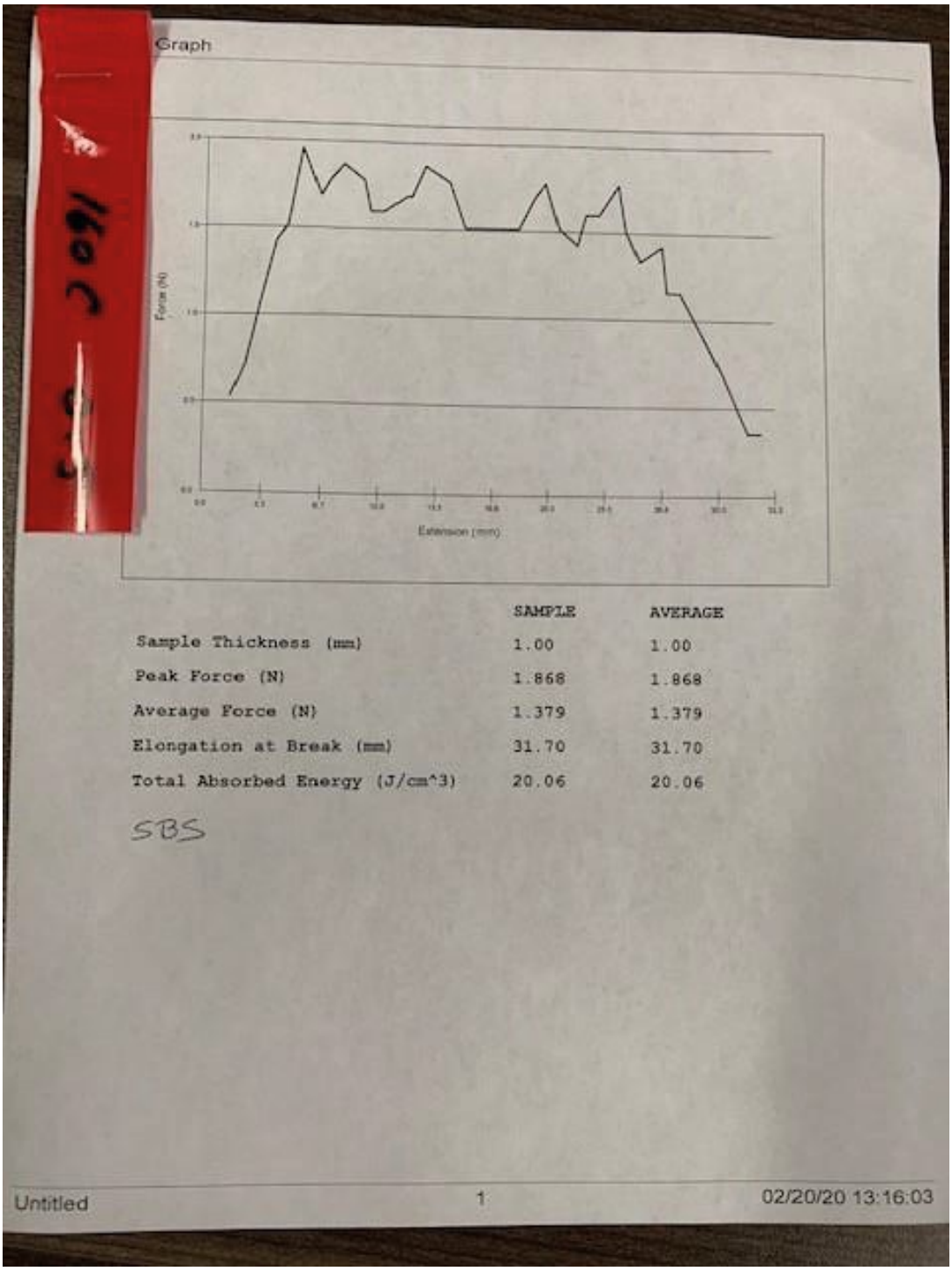
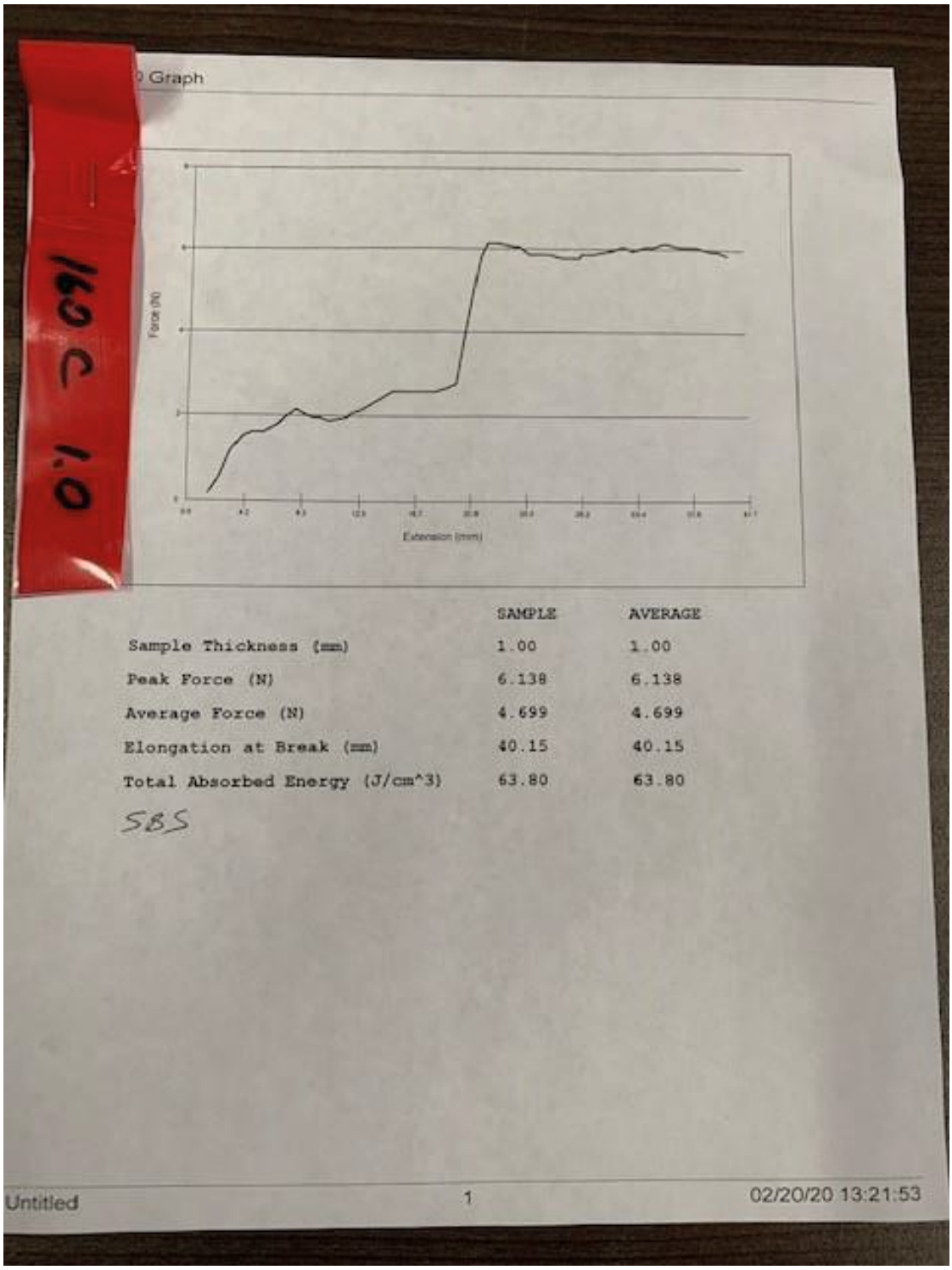
SBS 150C /1.0 DWELL TIME

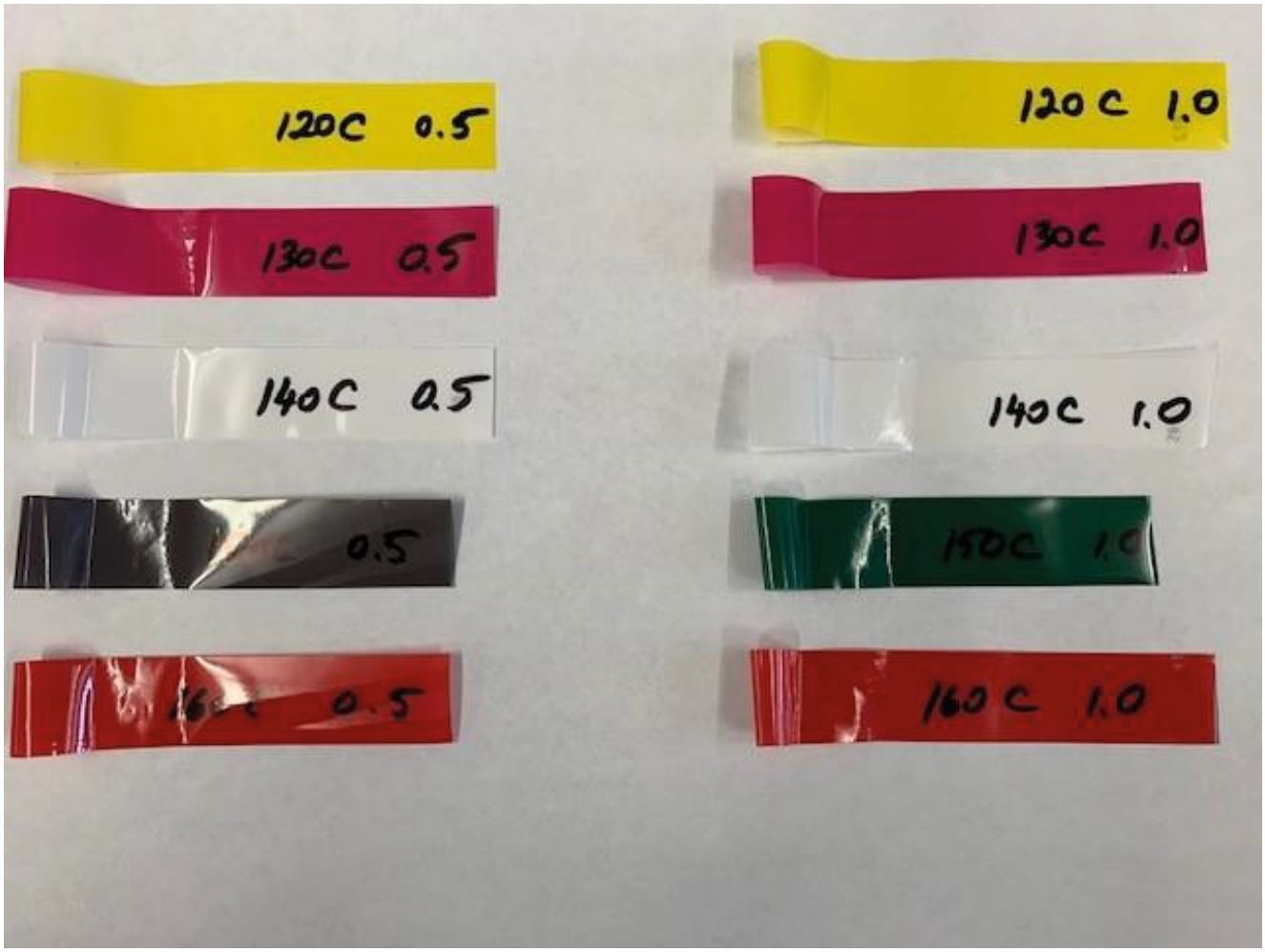


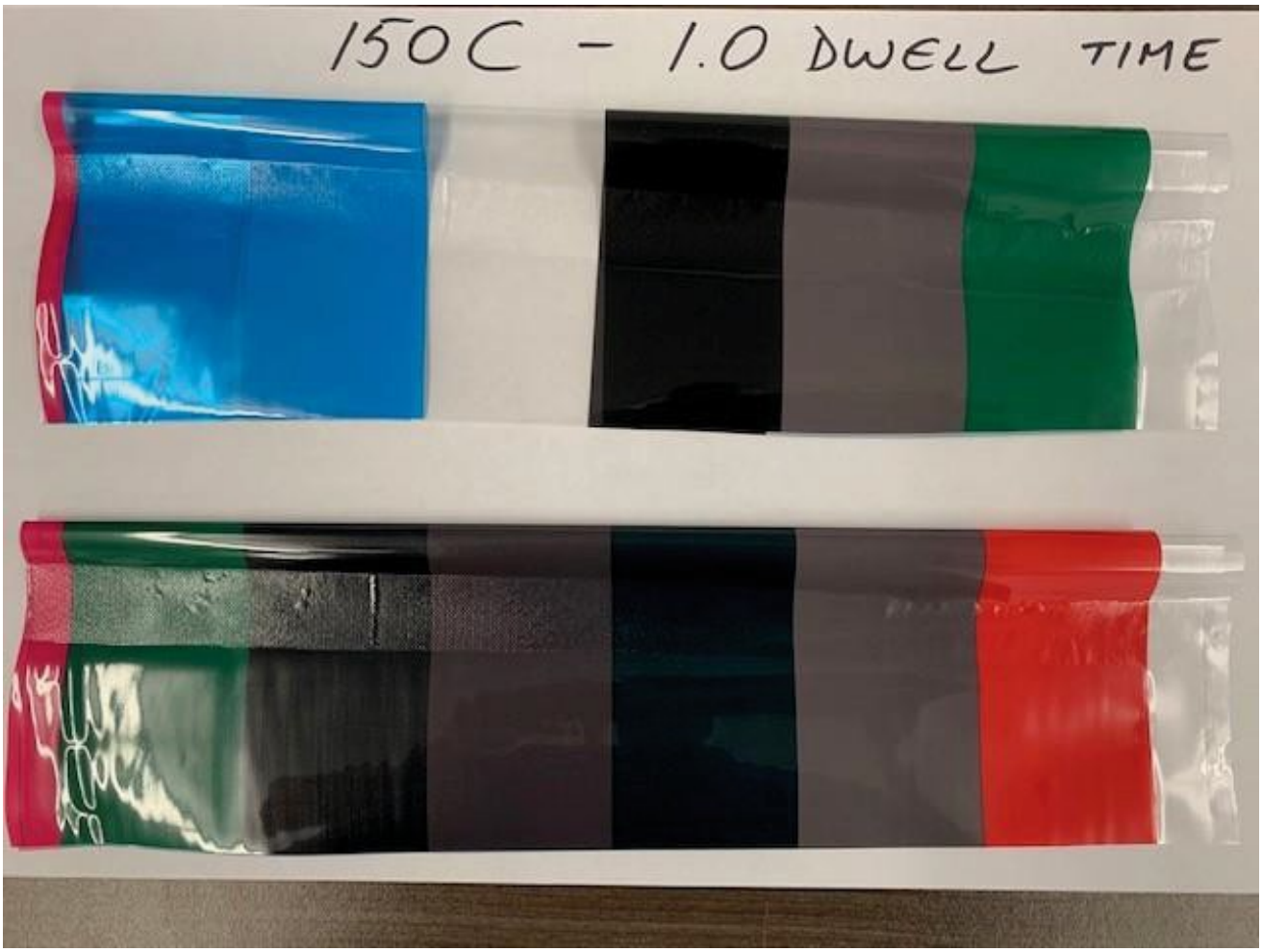
160C / 0.5


Graph
Force (N)
Extension (mm)
SAMPLE AVERAGE
Sample Thickness (mm) 1.00 1.00
Peak Force (N) 1.868 1.868
Average Force (N) 1.379 1.379
Elongation at Break (mm) 31.70 31.70
Total Absorbed Energy (J/cm^3) 20.06 20.06
SBS
Untitled
1
02/20/20 13:16:03

160C / 1.0 DWELL TIME




120C 0.5
120C 1.0
130C 0.5
130C 1.0
140C 0.5
140C 1.0
0.5
160C 1.0


150C - 1.0 DWELL TIME

Summary:

A thermal adhesive polymer (EVA) 25.5 um BOPP Gloss from Cosmo was used and laminated over a surface printed HS BOPP.

Appearance, LBS and SBS values of the laminated material exceeded the acceptance criteria when using the parameters listed in Table #3.

Overall, the Cosmo BOPP with EVA TAP resin laminated to a surface printed BOPP pass the feasibility trial for resulting in good LBS, SBS and COF values along with good appearance and rapid set up (less than 50 M).

We recommend sealing at 150C and 1.0 seconds dwell time.