



Validation Report: TORAY



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

Date: August 5,
2021

(Supplier & Product) TORAY CTHL040 SOFT MATTE - 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 to Israel:

- 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
CTHL040	SOFT MATTE	EVA	24.4 µm	749	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-019	QT 400 QUICK TEAR WHITE LAMINATE 100 µm	SURFACE	TORAY CTHL040 SOFT MATTE	TOP	124.4 µm

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-019	120	60	3.0	3.0	100	5	8	12	5	3.0/3.0	75

1. Pre-lamination – film inspection remarks:

- ▶ Curling score (in cm TD and MD): NO CURL
- ▶ Thermal active layer coating quality: GOOD
- ▶ Visual defects: N/A
- ▶ Comments: N/A



2. Post lamination results:

Exp. #	Composition	AVG. LBS [N/in] (Failure mode*)						Visual Appearance			
			Left side of hot drum			Right side of hot drum			Curling	Wrinkles	Pinching
			OS			GS					
	Patch 22	Patch 16	Patch 11	Patch 22	Patch 16	Patch 11					
RS-019	WHITE PRE-LAM/ INK/TORAY SOFT MATTE	t=0	3.9	4.5	4.3	4.3	4.0	4.1	N/A	N/A	N/A
		t=24	4.0	3.9	4.3	5.3	3.8	3.9			

* 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

SBS Test – will be done on strips: 19, 20, 21, 22, 23, 24 – please add Photo of sealing area, for visual appearance:

SBS TESTES CRITERIA

SEAL LAYER	Pass [N/Inch]	Fail [N/Inch]
BOPP	SBS > 4 or <6	SBS <4 or SBS >6

3. Sealing bond strength results:

Exp. #	Composition	Sealable ply	Dwell time [sec]	SBS [N/in]				
				170C	180C	190C	200C	210C
RS-019	WHITE PRE-LAM/ INK/TORAY SOFT MATTE	PE	0.5	X	41.2	X	X	X
			1	X	53.1	X	X	X



4. Sealed are appearance:

Exp. #	Composition	Sealable ply	Dwell time [sec]	SBS [N/in]				
				170C	180C	190C	200C	210C
RS-019	WHITE PRE-LAM/ INK/TORAY SOFT MATTE	PE	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 - In to in (Seal)	0.20 – 0.30	COF <0.20 or >0.31
VFFS - Out to Out (Print)	0.25 – 0.35	COF <0.24 or >0.36
HFFS - In to in (Seal)	0.20 – 0.45	COF <0.20 or >0.46
HFFS - Out to Out (Print)	0.25 – 0.45	COF <0.24 or >0.46



EXP #: RS-019		IN / IN (SEAL)	OUT / OUT (PRINT)
		KINETIC COF	KINETIC COF
LAMINATED CONSTRUCTION	# 1	0.226	0.56
	#2	0.190	0.55
	#3	0.208	0.51
	#4	0.20	0.46
	AVG	0.20	0.52
	STD	0.02	0.05
TEST ON NON-LAMINATED FILM WILL BE DONE ON EMPTY SIDE			
NON-LAMINATED THERMAL FILM	#1		0.76
	#2		0.71
	#3		0.89
	#4		0.81
	AVG		0.79
	STD		0.07



Summary:

Results show that the adhesion performance between the digitally surface printed QT 400 QUICK TEAR WHITE LAMINATE and the TORAY SOFT MATTE Thermal Film meets the acceptance criteria as per the HP's Validation Protocol - *See Table #3 for best working conditions / process parameters.*

- Lower nip pressure than 3.0 bar resulted in low LBS.
- Lower speeds and higher temperature resulted in curling in TD and MD (60M/minute or higher recommended).

Based on the SBS test results and appearance the suggested sealing temperature should be 180C and 1.0 second dwell time. Temperature above 180C and 1.0 sec dwell time resulted in poor visual appearance, ink discoloration and bad wrinkles. Lower temperature than 180C resulted in weak SBS and poor visual appearance.

The lamination of TORAY SOFT MATTE to the surface printed pre-lam resulted in acceptable LBS, SBS and great appearance without any curl and very easy to work with. Only 200 meters of material has been used to pass the validation based on HP's validation protocol. Furthermore, the validation of TORAY SOFT MATTE has been a great success.

See pictures below:





