



BETTER PACKAGES, Inc.
255 Canal Street
Shelton, CT 06484

Attn: Kimberly Poeta

Test Report No: 3413302PP01

Date: 5 February 2014

SAMPLE(S) SUBMITTED

BY THE CLIENT AS: Thirteen-hundred (1300) flat cardboard single wall cartons 18"x12"x14", ten (10) 70 mm wide paper tape rolls KRM450-10 with water activated adhesive, and a box with 12 rolls of plastic based adhesive tape 3M #371, 48 mm wide.

DATE OF RECEIPT: 22-28 January 2014

TEST PERIOD: 28 January – 4 February 2014

TEST(S) REQUESTED:

- Productivity assessing of Better Packages staff assembling boxes using water-activated tape dispenser and hand-held plastic tape gun;
- Integrity of assembled boxes at varying atmospheric conditions (heat, cold, humidity);
- Adhesiveness of paper tape with water-activated adhesive and plastic based adhesive tape to boxes.

TEST RESULTS: See Pages 2-7.

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SIGNED FOR AND ON BEHALF OF
SGS NORTH AMERICA, INC.:

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TEST RESULTS

Test: **PRODUCTIVITY STUDY**

Materials and equipment used:

1. Cardboard single wall cartons 18x12x14

Manufacturer	Uline
Style	RSC
Size	18" x 12" x 14" (I.D.)
Certificate	Burst Strength – 200 psi Min Combined Weight of Facings- 84 lbs/ 1000 ft ²
Corrugations	Vertical "C" Flute
Facings	Kraft/Kraft (visual exam only)
Mfr's Joint	Glued
Identification	18x12x14; S-4237

2. Water-activated adhesive paper tape KRM450-10
Better Packages Reinforced Tape
70 mm x 450 ft; K79087

3. Plastic based adhesive tape
Scotch; 3M 371
48 mm x 109 yards

4. Better Packages tape dispenser, Model 555e

5. Hand-held tape gun – 2 inches wide.

Test procedure:

Study was conducted at the SGS warehouse area (Fig. 1) for two 8-hour work days. A work day has included working station preparation, box assembling, two 15 min breaks and 30 minutes lunch time, box evaluation, disassembling and discarding boxes. The effective time for box preparation was limited to 6 hours each day. The first day Better Packages staff has assembled provided flat cardboard cartons using water activated tape dispenser and the second day applying a plastic tape using a hand-held tape gun. Top and bottom flaps of each box were sealed with a single piece of tape long enough to overhang to the side of the box and thus to secure the box functionality. It was agreed that a 3 in. paper tape overhang and 4 in. long plastic tape will provide approximately the same sealing surface to the side of the cardboard box. Thus the single paper tape cut was estimated to be 24 in. long and the plastic tape cuts– 26 in. long each. The number of box assembled, total length of tape used and scrap length was recorded and were used to calculate the each assembly method productivity and the tape used per box sealed.



Fig. 1 Cardboard box sealing.

Tape	Boxes sealed	Box/hour	Total tape length	Scrap	Tape/box	Single tape cut
Paper w/Water-activated adhesive	649	108.2	2550 ft	13 ft	47.2 in.	23.45 in.
Plastic based adhesive tape	535	89.2	2295 ft	7 ft	51.5 in	28.66 in.

Note:

The determined single paper tape cut of 23.45 in. is in accordance with the results of additionally measured 10 tape cuts lengths when the BetterPack 555e machine was set up at 24" and the machine "Repeat" button was used multiple times (Avg = 23.34 in.; St. Dev. 0.23 in.). Paper tape sealed boxes were found to be more uniform and had a better appearance.

Comment:

1. The productivity, defined as a number of boxes sealed per hour, using Water-activated tape dispenser was found to be 21% higher than using Hand-held guns with Plastic tape.
2. The average tape needed to seal a single box using Water-activated paper tape was 8% less than using plastic based tape.

Test: **INTEGRITY OF ASSEMBLED BOXES AT VARYING ATMOSPHERIC ENVIRONMENT**

The integrity of 10 boxes assembled using paper and 10 boxes assembled using plastic tape was evaluated after 24 hrs conditioning at each of following 3 different environments:

Labratory (23°C and 50%RH) - Standard,
 Hot/Humid (40°C and 75%RH) – Tropical, and
 Severe Cold (-18°C, RH Not controlled) – Arctic.

After each conditioning the assembled boxes were tested for ease of pilferage by pressing down at the center of the top flaps, ½ - ¾ in. off the tape edge, to determine if the seal could be broken.

An Instron testing machine was used to apply a compressive force (Fig.2) at a speed of 12 in/min and to register the force needed to open the box along to sealing tape, to tear the tape, or to break the box.



Fig.2 Integrity testing set up

Simulated severe treatment of sealed cardboard cartons with up to 5 inches flexing of top surface trying to break down the box integrity, Fig. 3.



Fig. 3 Box integrity testing

TEST RESULTS, CONT'D

Material: CARDBOARD CARTONS SEALED WITH PAPER TAPE WITH WATER-ACTIVATED ASDHESIVE

Max Force (lb)

Conditioning	STANDARD	TROPICAL	ARCTIC
	53.78	51.19	57.79*
	45.98	55.39*	56.71
	65.45	49.91	64.30
	60.64	50.39*	54.06
	63.15	52.98	56.61
	58.24	49.19	61.61*
	64.13*	44.14	62.95
	59.35	54.84	67.14
	64.06	57.28	62.40
	66.72	49.74	59.51
Average	60.15	51.51	60.31

Note:

No paper tape peel off detected after all environmental box conditionings.
 Severe flexing of boxes observed without loosing the box integrity, Fig.3, Left.
 For samples noted with * a tape tear along the flap occurred at about 4 in. box compression.
 The lower Max Compression Force revealed after Tropic (Hot and Humid) conditioning is associated with cardboard stiffness change.

Comment:

The box closure with Paper tape with water-activated adhesive secures the box integrity and prevents unnoticed incursion of the packed products at all environmental conditions: Standard, Hot/ Humid, Severe Cold.

TEST RESULTS, CONT'D

Material: CARDBOARD CARTONS SEALED WITH PLASTIC BASED ADHESIVE TAPE

Max Force (lb)

Conditioning	STANDARD	TROPICAL	ARCTIC
	18.16	11.70	14.13
	16.91	13.49	14.96
	17.01	12.27	14.52
	15.89	13.11	14.47
	16.80	9.69	15.25
	15.02	12.52	13.08
	16.57	12.11	14.17
	15.64	13.91	14.62
	20.35	14.42	13.73
	<u>15.64</u>	<u>13.09</u>	<u>17.17</u>
Average	16.80	12.63	14.61

Note:

Observed a massive plastic tape peel off at 1-1.5 inch box flex, Fig. 3, Right.
 The maximum force needed for box opening is relatively low – 10-20 lbs and attainable for an average person. The box and tape are almost not damaged and it is hard to detect such intrusion because both the box and tape appear intact.
 The plastic tape adhesion is affected by the environmental conditioning. After Tropical conditioning (high hot/humidity exposure) it is 25% lower and after Arctic conditioning (exposure to severe cold) it is 13% lower than at the standard condition.

Comment:

It is our opinion based on the above findings that plastic tape can not secure the boxes integrity or prevent the package from incursion at all environmental conditions: Standard, Hot/ Humid, Severe Cold.

TEST RESULTS, CONT'D

Test: **ADHESIVENESS TO BOXES
OF PAPER TAPE WITH WATER-BASED ADHESIVE AND PLASTIC BASED ADHESIVE TAPE**

TACKINESS IN 5 SECONDS

Material:	PAPER TAPE		PLASTIC TAPE	
	Dir.1	Dir.2	Dir.1	Dir.2
	Pass	Pass	Fail	Fail
	Pass	Pass	Fail	Fail

Note: 1. Pass – Pronounced tackiness. Removing the tape after causes a massive failure of the tape area.
2. Fail – Within 5 sec after applying the tape insufficient tackiness revealed.

ADHESION AFTER 24 HOURS

Material:	PAPER TAPE		PLASTIC TAPE	
	Dir.1	Dir.2	Dir.1	Dir.2
	Pass	Pass	Fail	Fail
	Pass	Pass	Fail	Fail

Note: 1. Pass – Pronounced tackiness. Removing the after 24 hrs it application causes a paper failure of more than 80% of the tape area.
2. Fail – An insufficient tackiness observed. Tape removed easily capturing just some cardboard paper fibers.
3. Dir.1 – Direction along the flutes; Dir. 2 – Direction across the flutes.

Comment:

The paper tape with water-based adhesive has a stronger adhesiveness to cardboard carton surface than the plastic based adhesive tape.

We trust the results will prove useful and informative. Should you have any questions, please feel free to contact us

END OF REPORT