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Methodology Article **Open Access**

Peel Test Comparison

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Abstract Three standardized peel test variations; unrestrained, 90^{o} restrained and 180^{o} restrained, for testing the integrity of edge sealed flexible pouches are compared in this article. A total of 30 samples of identically sealed pouches were tested for each method using standards set forth in ASTM F88/F88M-09. The three methods yielded consistent differences ranging from 40% between the 90^{o} restrained and unrestrained methods to 190% between the 90^{o} restrained and 180^{o} unrestrained methods.

Keywords *Peel Tests; Flexible Sealed Pouches; Medical Device*

1. Introduction

The use of flexible sealed pouches for protective product containers has gained wide acceptance in the medical device industry where atmospheric contamination of the product must be kept to a minimum if not eliminated entirely. Such containers typically consist of two flat impermeable or semi-permeable membranes “sandwiched” together and sealed on three sides as supplied by their manufacturer. This permits the medical device manufacturer to insert a product under appropriate sanitary conditions and then seal the remaining open side to form an air-tight protective capsule for shipping the product. The integrity of the seal is quantified by the force necessary to peel the two membranes apart– “The Peel Test”. There are three variations in the method to determine this force, however most companies choose only one for testing their product. The current experiment was conducted to investigate possible differences in results from the three variations and to provide a means for comparing results from future tests.

Industry standards for the testing of the integrity of the sealed edges of the pouch are set forth by ASTM (American Society for Testing and Material) specifically, ASTM F88/F88M-09 [1]. In this standard, restrictions are set for the three different methods of peel testing a fin seal as shown in

Figure 1. In the document, the appropriate apparatus and procedure is given with its specific uncertainty for each process. Potential interferences and bias are also discussed in this document. The ASTM standard is set in order for multiple companies to be able to compare and correlate peel test results.

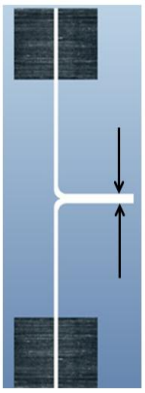
A search for previous work was conducted so that the results of the current research could be compared with others in order to validate the results. No previous work was found in relation to the experiment.

UNRESTRAINED

Each tail of the specimen is secured in opposing grips and the seal remains unsupported while the test is being conducted.

90° RESTRAINED

Each tail of the specimen is secured in opposing grips and the seal remains hand-supported at a perpendicular angle to the tails while the test is being conducted.



180° RESTRAINED

The least flexible tail is supported flat against a rigid alignment plate held in one grip. The more flexible tail is folded 180° and is held in the opposing grip while the test is being conducted.

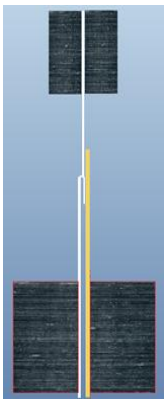


Figure 1: *Three Different Methods of Peel Testing a Fin Seal*

2. Materials and Methods

Peel tests were done in the CBU Packaging lab using a Tinius Olsen H5KS tensile tester (Figure 2) specially adapted for peel testing. In all, ninety test runs were done on samples prepared from sterile high density polyethylene. The pouch samples were all cut into one inch by three and half inch strips with one inch adhesive on each strip. All of the pouches were sealed using the same adhesive and sealing process. All tests were run at room temperature using either unrestrained, 90° restrained, or 180° restrained tail configuration at a jaw separation speed of 1 inch/min. The maximum peel force reached during each test run was recorded.

Figure 2: *H5KS Tensile Tester*

3. Results and Discussion

For the three testing methods, the results are shown in Table 1 and Figure 3 below.

Table 1: *Peel Force Data*

Sample	Test 1- Unrestrained	Test 2- 90^0 Restrained	Test 3- 180^0 Restrained
	Force (lbf)	Force (lbf)	Force (lbf)
1	1.87	1.24	3.93
2	1.65	1.31	3.9
3	1.76	1.09	3.75
4	2.29	1.01	3.82
5	1.54	1.39	4.05
6	1.76	1.31	3.97
7	1.87	1.2	3.93
8	1.84	1.16	4.08
9	1.72	1.2	3.93
10	1.69	1.35	3.86
11	1.91	1.57	3.97
12	1.76	1.35	3.63
13	1.95	1.65	3.67
14	1.84	1.27	3.71
15	2.25	1.54	4.05
16	1.91	0.97	3.63
17	1.84	1.5	3.9
18	1.91	1.54	3.86
19	2.02	1.39	4.01
20	1.80	1.46	3.48
21	1.46	1.61	3.93
22	2.02	1.27	3.75
23	2.25	1.24	3.67
24	2.10	1.05	4.01
25	1.87	1.39	3.52
26	1.65	1.27	3.75
27	2.32	1.2	4.2
28	1.72	1.76	4.16
29	1.31	1.31	4.01
30	1.99	1.46	3.97
Average (lbf)	*1.86*	*1.34*	*3.87*
STD Deviation (lbf)	*0.235*	*0.191*	*0.181*
STD Deviation (%)	*12.6%*	*14.3%*	*4.67%*

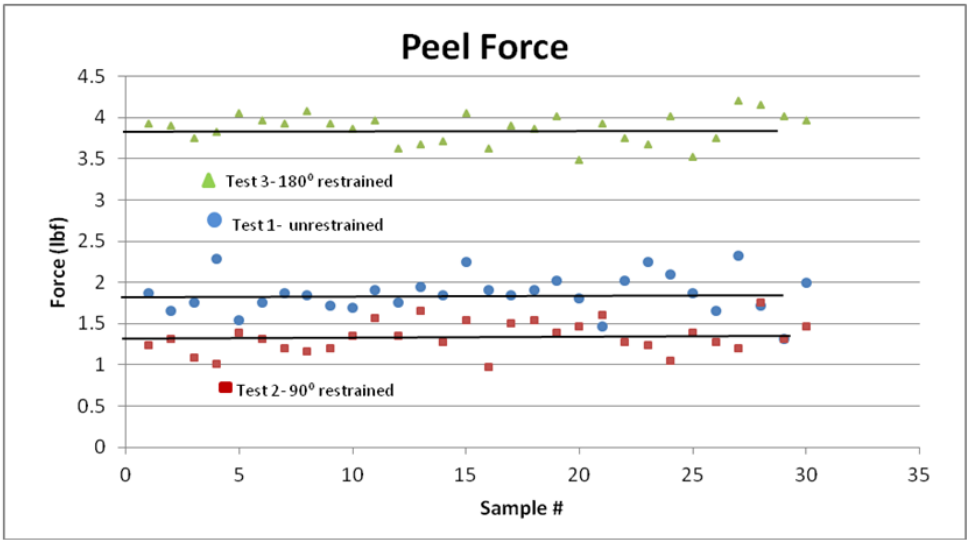


Figure 3: *Peel Force Results*

4. Conclusion

The unrestrained results had an average value of 1.86 lbf and a standard deviation of 12.6% of the average value as shown in Table 1. The 90° restrained results had an average value of 1.34 lbf and a standard deviation of 14.3% of the average value as shown in Table 1. The 180° restrained results had an average value of 3.87 lbf and a standard deviation of 4.67% of the average value as shown in Table 1. A comparison of the three tests is shown in Figure 3. The 90^{o} restrained and unrestrained results are similar with averages of 1.34 & 1.86 lbf but the 180^{o} restrained results are significantly higher with an average of 3.87 lbf. The 180° restrained results were the most consistent of the three tests, possibly because it had a more stable constraint applied to the sample. The three methods yield consistent differences ranging from 40% between the 90^{o} restrained and unrestrained methods to 190% between the 90^{o} restrained and 180^{o} unrestrained methods. In view of these significant differences, it is recommended that any reporting of peel test data must include the testing method used.

Acknowledgement

This paper was previously published in the Proceedings of the MAESC 2012 Conference (May 2012) as part of the paper entitled “Packaging Analysis.” Use with permission from Christian Brothers University.

Reference

[1] ASTM Standard F88/F88M-09, 2009: *Standard Test Method for Seal Strength of Flexible Barrier Materials*. ASTM International, West Conshohocken, PA.