Proceedings of the 2013 HPC Spring Meeting

Friday, April 19, 2013
Sabbatini Lounge
Christian Brothers University
650 East Parkway South
Memphis, TN 38104
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- Wooden Pallet Study @ CBU
- Global Lasallian Packaging Alliance

Additional Materials
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- Slides: Correlating Peel and Burst Test Data for Unrestricted Pouches with Fin Seal Edges
- Slides: Wooden Pallet Study @ CBU
- Slides: Global Lasallian Packaging Alliance

Sponsors
- National Wooden Pallet & Container Association
- Southern Growth Studio
- The Pallet Factory
- WS Packaging

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Registered Participants

1. James Aflaki       Christian Brothers University
2. John Archer       Christian Brothers University
3. Phyo Aung         Christian Brothers University
4. Chad Baker        Christian Brothers University
5. Julie Blair       Medtronic
6. Divya Choudhary   Christian Brothers University
7. Ray Brown         Christian Brothers University
8. Debbie Coke       Olympus Surgical Technologies America
9. Keith Councell    Olympus Surgical Technologies America
10. Josh Doyle       The Pallet Factory
11. Michael Doyle    The Pallet Factory
12. Barbara Enright  WS Packaging
13. Luis Garcia      Christian Brothers University
14. Jay Gilman       FedEx
15. Chrystal Goldman FedEx
16. Michael Gruber   Southern Growth Studio
17. Mallory Harvey   Christian Brothers University
18. Patrick Held     Christian Brothers University
19. Steve Hjerpe     The Pallet Factory
20. Chisalo Jones    Christian Brothers University
21. Rhett Jordan     Christian Brothers University
22. Joni Leonardo    NWPCA
23. Pong Malasri     Christian Brothers University
25. Griselda Matos   Christian Brothers University
26. John McLeod III  NWPCA
27. Bob Moats        Christian Brothers University
28. Daniel Olivares Vera Universidad DeLaSalle, Leon, Mexico
29. Ali Pourhashemi  Christian Brothers University
30. Elaine Pryor     The Pallet Factory
31. Asit Ray         Christian Brothers University
32. Nathan Sampson   Christian Brothers University
33. Bill Schmertz    Merck
34. Melissa Simpson  Merck
35. Alvin Siow       Christian Brothers University
36. Ryne Stevens     Christian Brothers University
37. Tom Sullivan     Christian Brothers University
38. John Varriano    Christian Brothers University
39. John Ventura     Christian Brothers University
40. Norman Witteborg Wright Medical

Healthcare Packaging Consortium Members
Evergreen Packaging, FedEx, Medtronic, Merck Consumer Care, Olympus Surgical Technologies
Plastic Ingenuity, Smith & Nephew, The Pallet Factory, Wright Medical, WS Packaging
## 2013 HPC Spring Meeting

**Friday, April 19, 2013**

Sabbatini Lounge, 2nd Floor of Thomas Center, Christian Brothers University

650 East Parkway South, Memphis, TN 38104

<table>
<thead>
<tr>
<th>Time</th>
<th>Activities</th>
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| 8:00 a.m. – 8:45 a.m. | • Check-in/Continental Breakfast  
                        | • Poster Session                                                            |
| 8:45 a.m. – 10:15 a.m. | • Seminar 1: Pressure Sensitive 101  
                        |   Barbara Enright  
                        |   WS Packaging                                                            |
| 10:15 a.m. – 10:30 a.m. | • Coffee Break                                                             |
| 10:30 a.m. – 12:00 noon | • Seminar 2: Design of Wood Pallets to meet Unit Load Handling System  
                        |   Requirements  
                        |   John McLeod III, Director, The Pallet Design System  
                        |   NWPCA                                                                  |
| 12:00 noon – 1:00 p.m. | • Lunch                                                                    |
| 1:00 p.m. – 1:15 p.m. | • Keynote Address: Consumer Empathy & Packaging Healthcare  
                        |   Michael Graber  
                        |   Southern Growth Studio                                                 |
| 1:15 p.m. – 2:45 p.m. | • Seminar 3: Healthcare Packaging Consortium  
                        |   • Correlating Peel and Burst Test Data for Unrestricted Pouches with  
                        |   Fin Seal Edges, Ray Brown and Asit Ray  
                        |   • Wooden Pallet Study @ CBU, Pong Malasri, Ali Pourhashemi, James  
                        |   Aflaki, and Tom Sullivan  
                        |   • Global Lasallian Packaging Alliance, Pong Malasri and Daniel Olivares Vera |
| 2:45 p.m. – 3:00 p.m. | • Coffee Break                                                            |
| 3:00 p.m. – 4:30 p.m. | • HPC Representatives Meeting                                              |

Campus Map: [http://www.cbu.edu/about/campusmap.html](http://www.cbu.edu/about/campusmap.html)

**Sponsors:**

- Southern Growth Studio
- WS Packaging
- The Pallet Factory
- National Wooden Pallet and Container Association (NWPCA)

**Healthcare Packaging Consortium Members**

*Evergreen Packaging, FedEx, Medtronic, Merck Consumer Care, Olympus Surgical Technologies  
  Plastic Ingenuity, Smith & Nephew, The Pallet Factory, Wright Medical, WS Packaging*
Abstracts
Pressure Sensitive 101

Barbara Enright

Abstract: This seminar gives an overview of Pressure Sensitive 101. It covers a general discussion of manufacturing and applications of different adhesives. Topics include:

- The PS Sandwich
- The Manufacturing Process
- Paper & Film Facestocks
- Adhesives
- Liners

Keywords: Pressure Sensitive sandwich, paper, film, adhesives, liners

Author:

Barbara Enright – Barbara is Senior Account Manager with WS Packaging for 17 years. She has over 25 years in the printing industry with a degree in Graphic Design and Print Reproduction. She has participated in consulting with raw material supplies regarding new products for linerless and multi-layer applications from an end-user perspective. Last year Barbara won the MVP award from WS Packaging.

1 WS Packaging (Memphis Office), 1138 N. Germantown Pkwy., Suite 101, PMB # 320, Cordova, TN 38018, BEnright@wspackaging.com
Design of Wood Pallets to meet Unit Load Handling System Requirements

John A. McLeod III

Abstract: Pallets are the key component to successful unit load material handling. The pallet is the interface between the equipment, forces and impacts of the material handling environment and the valuable, sometimes fragile, unitized load.

This presentation will address the requirements of pallets in unit load material handling systems and design of wood pallets to meet those requirements. Use of The Pallet Design System© (CAD/CAE software) will be integrated with this discussion and presentation.

Keywords: Wood pallets, unit load handling, The Pallet Design System

Author:

John A. McLeod III – Mr. McLeod earned a B.S. in Wood Science and Technology from North Carolina State University in 1981 and a M.S. in Wood Engineering from Virginia Tech in 1985. From 1985-2005, McLeod was a Senior Research Associate at Virginia Tech where he conducted research related to wood pallet design and performance, and continually developed NWPCA’s The Pallet Design System© (PDS). Since 2005, McLeod has been employed by NWPCA (National Wooden Pallet and Container Association) as Director of PDS, and is working on its transformation to a unit load design system.

1 National Wooden Pallet & Container Association, 1421 Prince Street, Suite 340, Alexandria, VA 22314-2805, jmcleod@palletcentral.com
Consumer Empathy & Packaging Healthcare

Michael Graber

Abstract: This Keynote Address will explore how human-centered design and Design Thinking techniques, as well as consumer packing design trends, are beginning to be used to inspire the design of healthcare products. This address will give evidence of this growing trend while also outlining the basic methodology of the Design Thinking approach.

Topics will include:

- Designing with empathy for consumers and users
- Beginning by immersion into the problem to be solved
- Breakthroughs in healthcare product and healthcare packaging design using this technique
- Design Thinking overview

Keywords: Healthcare, Design Thinking, human-centered design, consumer-friendly packaging

Author:

Michael Graber - Michael is Co-Founder and Managing Partner at Southern Growth Studio. Michael leads the qualitative team with a particular focus on innovation, to deliver high-impact go-to-market strategies and product launches. Michael has more than twenty years of experience leading marketing and innovation efforts. An expert in experiential marketing and user interface, Michael has consulted across a wide range of industries through his work at iXL and advertising agencies. He previously founded Johnson|Graber, a successful interactive marketing firm that was acquired by Memphis-based Lokion in 2004. Also an accomplished brand strategist, Michael has advised a myriad of clients on the positioning strategy and value proposition. A published poet and musician, Michael is the creative force that compliments the analytical side of the house. Michael speaks and publishes frequently on best practices in marketing, business strategy, and innovation.
Correlating Peel and Burst Test Data for Unrestricted Pouches with Fin Seal Edges

Ray Brown¹ and Asit Ray²

Abstract: Peel and Burst tests are two of the three prevalent standard methods used to test the integrity of sterilized medical device packages. The burst test is faster, easier and more economical and as such is preferred by pouch suppliers and medical device manufacturers for quality control and validation purposes. The models developed using earlier runs based on four sizes of pouches [1] were extended to five more samples of different width/length ratios. Peel and burst tests were run on nine sets of these pouches of varying sizes, made of the same materials and sealed with the same adhesives and sealing processes. Three models developed from basic principles were used to correlate the results. Reasonable correlations were obtained using two of the models for pouch width/length ratios of .5 and higher. Further tests are in progress.

Keywords: Peel test, burst test, pouches, fin seal edges

Reference:


Authors:

Ray Brown – Dr. Brown is Professor Emeritus of Mechanical Engineering at Christian Brothers University. He earned his Ph.D. from the University of Notre Dame. He has also served as mechanical engineering department chair and engineering dean at CBU. His interests include mechanical and thermal systems. He is a member of ASME.

Asit Ray – Dr. Ray is Professor of Chemical Engineering at CBU. He earned his Ph.D. from Lehigh University. He spent seven years in the polymer industry and is actively engaged in laboratory research in polymeric and biomaterials. He teaches various packaging classes at CBU, including principles of packaging, distribution and medical device packaging, and sustainability. He is a member of IoPP and AIChE.

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Wooden Pallet Study @ CBU

Siripong Malasri¹, Ali Pourhashemi², James Aflaki³, and Tom Sullivan⁴

Abstract: This presentation gives a summary on various aspects of the wooden pallet study at Christian Brothers University. Finished work includes:

- Effect of high temperature on compressive strength and impact acceleration of new softwood pallets [1]
- Water absorption of wooden pallets [2]
- Effect of water content on compressive strength and impact properties of new softwood pallets [3]

On-going work includes:

- Effect of wet-dry process on softwood mechanical properties
- Effect of a forklift’s fork shape/size on the impact acceleration when a fork hits a softwood pallet stringer
- Mold study

Keywords: Compressive strength, impact property, softwood pallets, wet-dry process, mold, fork shape/size

References:


Authors:

Siripong Malasri – Dr. Malasri is a Professor of Civil Engineering at Christian Brothers University, where he also serves as the Packaging Department Chair and Healthcare Packaging Consortium Coordinator. He is a registered professional engineer in the State of Tennessee and is an ISTA certified packaging laboratory technician. He has authored various publications related to transport packaging. Dr. Malasri is a member of NSPE, IoPP, and TAPPI.

Ali Pourhashemi – Dr. Pourhashemi is Professor of Chemical Engineering at CBU. He earned his Ph.D. from the University of Maryland at College Park. He has authored and co-authored various publications in the areas of fluid mechanics, heat/mass transfer, and instrumentation. Dr. Pourhashemi is a member of the American Institute of Chemical Engineers.

James Aflaki – Dr. Aflaki received his Ph.D. in Mechanical Engineering from the University of Maryland at College Park. His specialty is in the area of thermal fluids and his sub-specialty is in the area of computer applications and MIS. He has over twenty years of teaching, research, and industry experience in mechanical engineering, MIS, design, and automation. He has received the best paper award from the Computer and Information in Engineering Division of ASME International. He is also a Founding Member of Informing Science Institute, InSITE.

Thomas J. Sullivan – Br. Thomas Sullivan, FSC is an adjunct professor in biology at CBU. He received his Ph.D. in Botany from the University of Minnesota. His specialty is lower plants, especially algae, fungi and lichens. He has over 40 years of teaching experience both in the United States and in Nairobi, Kenya, Africa.

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Global Lasallian Packaging Alliance

Siripong Malasri and Daniel Olivares Vera

Abstract: Christian Brothers University established the Healthcare Packaging Consortium on June 1, 2010, with seven founding member companies: Evergreen Packaging, FedEx, Medtronic, Merck Consumer Care, Plastic Ingenuity, Smith & Nephew, and Wright Medical. Since then, The Pallet Factory, Olympus Surgical Technologies, and WS Packaging have also joined the consortium.

Research projects, as shown below, were given to CBU by consortium member companies. CBU faculty, staff, and students have worked on these projects with assistance from member companies. Results have appeared in various publications; ten conference proceeding papers and four journal articles so far.

- Peel Testing Analysis (Sponsored by Smith & Nephew)
- Correlation Between Burst Testing & Peel Testing (Sponsored by Smith & Nephew)
- Distribution Tote Testing (Sponsored by Merck Consumer Care)
- The Impact of 100% Recycled Packaging Content to Performance (Sponsored by FedEx)
- Performance of Different Pallet Materials and Styles Under Diverse Handling and Environmental Conditions (Sponsored by FedEx)

To expand its packaging research capability, CBU has attempted to bring some universities/colleges from the worldwide Lasallian network to form the unique Global Lasallian Packaging Alliance. The Universidad DeLaSalle in Leon, Mexico, has agreed to collaborate with CBU on packaging research with the ultimate goal toward the formation of the global alliance. Other potential Lasallian universities/colleges are located in Spain, France, the Philippines, Malaysia, and Brazil.

This presentation shows the potential of establishing the world’s largest packaging alliance and benefits to CBU Healthcare Packaging Consortium member companies as well as entire global packaging industry.

Keywords: Packaging research, global packaging network, worldwide Lasallian network

Authors:

Siripong Malasri – Dr. Malasri is Professor of Civil Engineering at Christian Brothers University, where he also serves as the Packaging Department Chair and Healthcare Packaging Consortium Coordinator. He is a registered professional engineer in the State of Tennessee and is an ISTA certified packaging laboratory technician. He has authored various publications related to transport packaging. Dr. Malasri is a member of NSPE, IoPP, and TAPPI.

Daniel Olivares – Mr. Olivares is Chair, Department of Industrial Engineering, Universidad DeLaSalle, Leon, Mexico. His expertise is in logistics. He is currently pursuing his doctoral degree.

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2 Industrial Engineering Department, Universidad DeLaSalle, Leon, Guanajuato, Mexico, dolivares@delasalle.edu.mx
ADDITIONAL MATERIALS
growth. (noun)
1. the act or process of growing.
2. increase.
3. development from a simpler to more complex stage.
4. development from another but related stage.

Like a plant, you are either growing or dying.
We help companies Grow.
We specialize in market strategy and innovation to help our clients make strategic moves in the marketplace.
• bring new products or services to the market
• expand into new markets
• redefine to gain market share

The Studio quickens client moves into new markets or stimulates innovative leaps within an existing space.
Bright individuals with diverse professional backgrounds to crack the code and solve complex problems.

business analysts
ad agency veterans
interactive specialists
economists
MBAs
social anthropologists
mathematicians
Don’t just add to the sea of sameness
Audience

The chopping block.

Remember who uses the product or package you are designing.

Design Thinking in Brief

Methods for investigating ill-defined problems and posting human centric solutions.

Rapid generation and iterative testing.

1. Empathize.
2. Define.
3. Ideate.
4. Prototype.
5. Test.
6. Redesign.

Keep the designs centered on the people using the products.
Adaptive Path used the design thinking process to improve the user experience for those with chronic diabetes.

**Very Human Insights:**
- No vacation from diabetes
- Oppression of numbers
- In the way

"Medical device manufacturers are stuck in a bygone era; they continue to design these products in an engineering-driven, physician-centered bubble... Devices are also life devices," Amy Tenderich, Founder & Editor, Diabetes Mine
Charmr:
Six Design Principles

1. Wear it during sex.
2. Make better use of data.
3. Easy to learn and teach/No numbers.
4. Less stuff.
5. Keep diabetics in control.

Packaging Innovations in Healthcare.

REVITALIZATION.
Packaging Innovations in Healthcare.

REFINVENT.

Packaging Innovations in Healthcare.

REFRAME.
Product Innovations in Healthcare.

RETHINK.
Product Innovations in Healthcare.

RETHINK.
1. **Stu-dio**: workplace for the teaching or practice of an art
CORRELATING PEEL AND BURST TEST DATA FOR UNRESTRAINED POUCHES WITH FIN SEAL EDGES

Ray W Brown, Professor Emeritus, Mechanical Engineering, Christian Brothers University

Asit K Ray, Professor, Chemical Engineering, Christian Brothers University

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 TESTING STANDARDS:
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 Materials) and fall into one of two major types:

- **Peel Testing** in which samples of the sealed edge are cut into one-inch wide test strips and pulled apart much as one would perform a tensile test on a metal specimen in the laboratory. The force, $F_p$, required to “peel” the edges of a 1” specimen apart is a measure of the strength of the seal. The peel test is further subdivided into three sub-types depending on how the free edge (tail) of the sealed strip is supported.

- **Burst Testing** in which the entire sealed pouch is tested by inserting a hollow lance through the membrane to permit pressurizing the pouch. The pressure, $P_b$, at which the seal ruptures is a measure of the strength of the seal. The burst test is further subdivided into two sub-types depending on whether the pouch is kept between rigid plates parallel to its axis (restrained) or left free to inflate without constraints (unrestrained).

PREVIOUS WORK:

- **Wachala**, in 1991 presented an analytical and empirical study on correlating peel & burst test data. His final recommendation was that an empirical procedure showed the most promise.

- **Yam**, in 1993 reported the results of a study on correlating peel and burst test data for pouches. An analytic formula for the correlation, $P = 2S/D$, was presented for restrained testing of pouches where $S$ was the peel test strength, $D$ was the plate separation and $P$ was the burst pressure. Tests showed that this formula consistently overestimated the burst pressure.

- **Feliu-Baez**, in 2003 reported a rather extensive study of restrained burst testing of pouches that was based in part on her Master’s Thesis at Michigan State University in 2000. This paper also included the presentation of analytical models to correlate peel & burst data in restrained pouches. The authors reported that the analytic models did not provide a usable correlation and recommended an empirical method instead.
MODELS:

Peel Test:

![Peel Test Diagram](image1)

Figure 2 - Peel Test Specimen Under Load

Burst Test:

![Burst Test Diagram](image2)

Figure 3 - Burst Test Specimen Unpressurized And Pressurized
Analysis: Model w/o end effects

If the effects of the pressure forces on the ends of the pouch can be neglected, such as might be the case for a very long pouch, the model is reduced to a simple calculation of the pressure force along the sides of the pouch per unit length of seal. Equating this force to that obtained in a standard peel test then forms a basis for comparison. In the analysis following, stretching of the loaded membrane is ignored.

- \( w \) = interior width of the unpressurized pouch
- \( L \) = interior length of the unpressurized pouch
- \( D = \pi D = 2w \)
- \( A_H = \text{horizontal section area of the pressurized pouch} = DL = 2wL / \pi \)
- \( F_B = \text{total pressure force applied to the seal} = P_B A_H = P_B 2wL / \pi \)

Finally, the burst pressure force per unit length of seam, \( F_B/2L = P_B w / \pi \), should equal the corresponding peel force per unit sample length, \( F_P \). For comparison, it is convenient to form a ratio of these two quantities. For perfect agreement between peel tests and burst tests, \( R_1 = 1.0 \) and the degree to which \( R_1 \) varies from 1.0 is a measure of the accuracy of the correlation.

\[
R_1 = \frac{F_P}{(P_B w / \pi)}
\]

Analysis: Model with end effects

If the effects of the pressure forces on the ends of the pouch cannot be neglected, such as might be the case for a pouch whose width and length are roughly equal, the model is complicated slightly. In this case, the total pressure force along all four sides of the pouch must be determined and then used to determine the force per unit length of seal. As in the first case, equating this force to that obtained in a standard peel test then forms a basis for comparison. As shown in the top view in Figure 4, an inflated pouch may be expected to have perpendicular forces applied to the seal along the long side but the shortening of the width, \( w \), at the end will cause wrinkling and distortion. In order to create a simple model, it becomes necessary to ignore this complex behavior and assume that the force applied at the ends is also perpendicular to the seal. With this assumption, the analysis differs from the previous only in the way that the burst force per unit length of seal is calculated.

The burst pressure force per unit length of seam becomes:

\[
F_B/2(L+D) = (P_B 2w L/\pi)/2(L+D).
\]

As before, this should equal the corresponding peel force per unit sample length, \( F_P \), and again, it is convenient to form a ratio of these two quantities. For perfect agreement between peel tests and burst tests, \( R_2 = 1.0 \) and the degree to which \( R_2 \) varies from 1.0 is a measure of the accuracy of the correlation. It can be seen that Equation 2 reduces to Equation 1 as the ratio, \( w/L \), approaches zero (i.e. – a long, narrow pouch).

\[
R_2 = \left[ \frac{F_P}{(P_B w/\pi)} \right] [1+2w/\pi L]
\]
EXPERIMENTS:

- Peel tests were done in the CBU Packaging lab using a Tinius Olsen HSKS tensile tester specially adapted for peel testing. 100 runs were done on samples prepared from four different pouch sizes (twenty-five samples per pouch size) as listed in Table 2. 15-20 runs were done for each of the second group of five different pouch sizes as listed in Table 2 (cont’d). The pouch samples were all Tyvek/PET-PE and were provided by Wright Medical Technology (WMT). All of the pouches were sealed using the same adhesive and sealing process.

- All tests were run at room temperature using an unsupported tail configuration at a jaw separation speed of 12 inches/min. The maximum peel force reached during each test run was recorded.

EXPERIMENTS:

- Burst tests were done in the Wright Medical Technologies testing lab using a Test-A-Pack 2600 burst tester. Like the peel tests, one hundred test runs were done on four different pouch sizes (twenty-five test runs per pouch size) as listed in Table 2. The burst test pouch samples were also supplied by Wright Medical Technology and were identical in material and manufacture to those used in the peel tests. All burst tests were at room temperature using an unrestrained pouch.
### TABLE 2 - Peel & Burst Test Raw Data

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<td>(±6%)</td>
<td>0.16</td>
<td>(±16.9%)</td>
</tr>
<tr>
<td>Deviation</td>
<td>(±19.9%)</td>
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<td>0.16</td>
<td>(±10.6%)</td>
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### TABLE 2 (cont.) - Peel & Burst Test Raw Data

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<th>WMT-P/N 117894</th>
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<td>Inside</td>
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<td>7.375&quot; x 8.75&quot;</td>
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<tr>
<td>Test Run</td>
<td>F (lbf)</td>
<td>P_B (&quot;H2O)</td>
<td>F_B (lbf)</td>
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<td>F_B (lbf)</td>
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<td>26.7</td>
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<td>27.9</td>
<td>1.91</td>
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<tr>
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<td>1.835</td>
<td>35.8</td>
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<td>4</td>
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<tr>
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<td>1.311</td>
<td>32.5</td>
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<tr>
<td>21</td>
<td>2.44</td>
<td></td>
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<tr>
<td>Mean</td>
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<td>29.85</td>
<td>1.59</td>
<td>32.92</td>
<td>1.77</td>
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<tr>
<td>Standard</td>
<td>0.15</td>
<td>(±16.6%)</td>
<td>0.06</td>
<td>(±5.3%)</td>
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</tr>
<tr>
<td>Deviation</td>
<td>(±19.9%)</td>
<td>(±18.6%)</td>
<td>(±10.0%)</td>
<td>(±12.8%)</td>
<td>(±18.8%)</td>
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</table>
### TABLE 1 - Peel & Burst Test Correlation Results

<table>
<thead>
<tr>
<th>Source ID</th>
<th>ID # WMT-P/N</th>
<th>ID # WMT-P/N</th>
<th>ID # WMT-P/N</th>
<th>ID # WMT-P/N</th>
<th>ID # WMT-P/N</th>
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<th>ID # WMT-P/N</th>
<th>ID # WMT-P/N</th>
<th>ID # WMT-P/N</th>
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</thead>
<tbody>
<tr>
<td>Nominal Dimension</td>
<td>6.0&quot; x 3&quot;</td>
<td>10&quot; x 5&quot;</td>
<td>9.0&quot; x 4&quot;</td>
<td>14.25&quot; x 4&quot;</td>
<td>6.25&quot; x 16.5&quot;</td>
<td>6&quot; x 10&quot;</td>
<td>2.5&quot; x 11.5&quot;</td>
<td>8&quot; x 12&quot;</td>
<td>9.375&quot; x 12&quot;</td>
</tr>
</tbody>
</table>

Inside Width, w (in) | 2.25 | 4.25 | 5.25 | 3.75 | 5.5 | 5.5 | 2 | 7.5 | 9.375

Inside Length, L (in) | 3.875 | 7.625 | 8.5 | 11.625 | 14.5 | 7.75 | 9.625 | 9.4375 | 12

FP (lbf) | 1.99 | 1.85 | 2.31 | 1.79 | 1.63 | 1.59 | 1.96 | 2.13

FP Std Dev (lbf) | 0.12 | 0.16 | 0.06 | 0.1 | 0.32 | 0.29 | 0.25 | 0.40

PB (in H2O) | 98.44 | 49.81 | 81.43 | 47.15 | 20.85 | 32.92 | 53.11 | 32.79 | 27.1

PB Std Dev (in H2O) | 16.6 | 5.3 | 7.2 | 4.5 | 4.8 | 4.2 | 9.7 | 4.1 | 4.9

\[ R_1 = \frac{FP}{PBw/\pi} \]

Range (±1 Std Dev) | 0.63 to 1.0 | 0.85 to 1.14 | 0.85 to 1.14 | 0.77 to 1.14 | 0.80 to 1.14 | 0.77 to 1.14 | 0.90 to 1.14 | 0.80 to 1.14 | 0.77 to 1.14

\[ R_2 = R_1 [1 + 2w/\pi L] \]

Range (±1 Std Dev) | 0.86 to 1.37 | 1.45 to 1.25 | 0.90 to 1.35 | 1.00 to 1.35 | 1.00 to 2.30 | 0.82 to 1.32 | 1.23 to 2.34 | 0.84 to 1.35 | 0.75 to 1.59

### CORRELATION RATIO COMPARISON

Correlating Peel & Burst Data For Unrestrained Pouches

- **Gold - R1**
- **Red - R2**

**Correlation Coefficient, R (dim)**

<table>
<thead>
<tr>
<th>Pouch Width To Length Ratio, w/L (dim)</th>
<th>0.21</th>
<th>0.29</th>
<th>0.38</th>
<th>0.56</th>
<th>0.66</th>
<th>0.75</th>
<th>0.78</th>
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</thead>
<tbody>
<tr>
<td>Gold - R1</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
</tr>
<tr>
<td>Red - R2</td>
<td>0.2</td>
<td>0.3</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
<td>0.7</td>
<td>0.8</td>
</tr>
</tbody>
</table>

**Range (±1 Std Dev)**

- Gold - R1: 0.21 to 0.81
- Red - R2: 0.21 to 0.81
WEB BURST PRESSURE CALCULATION

BURST PRESSURE COMPARISON

Measured $P_B$ vs Web Calculated $P_B$

<table>
<thead>
<tr>
<th>Pouch Width To Length Ratio, w/L (dim)</th>
<th>Measured $P_B$ (in H2O)</th>
<th>Web Calculated $P_B$ (in H2O)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.21</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.29</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0.36</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>0.56</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>0.78</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

(Gold - Measured)
Red - Web Calculated
DISCUSSION:

- The correlation model w/o end effects, where $R_1 < 1.0$ for all four pouch sizes, consistently overpredicts the burst pressure by as much as 24%.

- In all but two cases, the correlation model that includes end effects yields results for $R_2$ that fall within acceptable limits with departures from the ideal, $R_2 = 1.0$, ranging from 0.0% to 16%. Additionally, the standard deviation ranges reported in Table 1 bracket the optimum, $R_2 = 1.0$, for all but one of the nine pouch sizes.

DISCUSSION:

- The fact that all values for $R_2$ are $> 1.0$ means that this model consistently predicts a burst pressure that is lower than expected. This is explainable and probably unavoidable, given the nature of the tests:
  - The pouches undergoing a burst test will always fail at the weakest point in the seal. This means that they always fail at the lowest possible value of the burst pressure.
  - In contrast, the peel test is done on samples taken at random locations from the sides of the pouch and may not include the weakest part of the seal. Even if that point is sampled, the overall effect of the sampling is to provide an average value of seal strength.
DISCUSSION:

- A satisfactory explanation of the disparity between results for low w/L ratios (<.5) and those for high w/L ratios (> .5) is not available.

- If the results from additional tests agree with the limited results presented by this study, then a correlation that is independent of pouch size, material, sealant and sealing process will have been established.
Wooden Pallet Study @ CBU

S. Malasri, A. Pourhashemi, J. Aflaki, and T. Sullivan

2013 HPC Spring Meeting
April 19, 2013

Outline

• Finished Work
  • Water Absorption
  • Effect of High Temperature
  • Effect of Water Content
• Preliminary Work
  • Molds
  • Effect of Wet/Dry Cycles
  • Fork Dimensions
Water Absorption


New Softwood
New Softwood Heat Treated
New Hardwood
New Hardwood Heat Treated
Used Softwood
Comparison of New and Used Softwood Pallet Specimens

SWN = New Softwood, SWU = Used Softwood

Water Penetration Rate

Time (min)

Water Penetration Height (in)

0 20 40 60 80 100 120 140 160 180 200

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5
Effect of High Temperature to Compressive Strength and Impact Acceleration of New Softwood Pallets

Effect of Water Content on Compressive Strength and Impact Properties of New Softwood Pallets

Effect of Wet Duration on Mold Growth – Preliminary Study

20 specimens per group

- Group 1: 100% wet duration (7 out of 7 days)
- Group 2: 57% wet duration (4 out of 7 days)
- Group 3: 29% wet duration (2 out of 7 days)
- Group 4: 14% wet duration (1 out of 7 days)
- Group 5: 0% wet duration (0 out of 7 days)
• Due to variability in wood, need to repeat the experiment with more specimens

Effect of Lights on Mold Growth – Preliminary Study

10 specimens per group

• Plant light
• Room light
• No light
• Due to variability in wood, need to repeat the experiment with more specimens.

Effect of Wet-Dry Process on Compressive Strength & Impact Property – Preliminary Study

Static Compression Test

• Need to repeat using more specimens and compress all specimens along grain (as shown) to be consistent.
Drop Test with Shock Recorder

- Need to repeat
- Not uniform drops
- Not much difference
- Use incline impact instead

Drop Test with Accelerometer

- Need to repeat
- Not uniform drops
- Use incline impact instead
Effect of Forklift’s Fork Size/Shape – Design of Experiment

Vary
• Fork tip angle
• Fork thickness
• Etc.
The Global Lasallian Packaging Alliance

Pong Malasri
Healthcare Packaging Consortium
Christian Brothers University

Daniel Olivares Vera
Industrial Engineering Department
Universidad DeLaSalle, Leon, Mexico

2013 HPC Spring Meeting
April 19, 2013

www.cbu.edu/packaging
### CBU Packaging Publications

<table>
<thead>
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<th>Calendar Year</th>
<th>Journal Articles</th>
<th>Conference Proceedings</th>
<th>Reports</th>
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www.cbu.edu/packaging
### Undergraduate Research

<table>
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<th>Calendar Year</th>
<th>Number of Undergraduate Students Involved in Packaging Research</th>
<th>Number of Publications Coauthored by Undergraduate Students</th>
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### CBU ISTA Certified Packaging Lab

- Certified by the Int’l Safe Transit Association
- One of seven certified packaging labs and the only one in an academic setting within the tri-state area of Tennessee, Arkansas, and Mississippi

**Lab revenue:**

- Maintaining equipment
- Small equipment acquisition

**Lab Manager:**

- Larry Rutledge
More than 100,000 lay colleagues, teach over 1,000,000 students in 80 countries.
Lasallian Education Worldwide

Africa
- Centre Lasallien Afrique (Abidjan, Cote d’Ivoire)

Central America
- Universidad De La Salle (San Jose, Costa Rica)
- Universidad La Salle (Mexico City, Mexico)
- Universidad La Salle (Guatemala, Guatemala)
- Universidad De La Salle (Chihuahua, Mexico)
- Universidad La Salle (Mexico City, Mexico)
- Universidad La Salle (Guadalajara, Mexico)
- Universidad La Salle (Guanajuato, Mexico)
- Universidad De La Salle (Queretaro, Mexico)
- Universidad La Salle (Cancun, Quintana Roo, Mexico)
- Universidad La Salle (Medellin, Colombia)

North America
- Christian Brothers University (Memphis, TN)
- La Salle University (Philadelphia, PA)
- Loyola University (Chicago, IL)
- Manhattan College (New York City, NY)
- St. Mary’s College (Moraga, CA)
- St. Mary’s University (Winona, MN)

South America
- Centro Universitario La Salle (Curitiba, Brazil)
- Universidad De La Salle (Santo Domingo, Dominican Republic)
- La Corporacion Universitaria Lasalle (Medellin, Colombia)

Asia
- Asean Institute (Kuala Lumpur, Malaysia)
- College of St. Benilde (Manila, Philippines)
- De La Salle University (Manila, Philippines)
- DLSU Daangin (Cavite, Philippines)
- University of Santo Tomas (Manila, Philippines)
- LASALLE College of Arts (Singapore)

Europe
- Institut Reims Astrid (Reims, France)
- Ecole Catholique D’Urs et Meliers (lyon, France)
- Universidad San Ramon (Lima, Peru)
- Escuela Universitaria La Salle (Madrid, Spain)

Middle East
- Bethlehem University (Bethlehem, Palestine)

www.cbu.edu/packaging

The Global Lasallian Packaging Alliance

R&D Collaboration

Networking
Opportunities for Universidad De La Salle, Bajio, Leon, MX

Mexico Population Growth

115M in 2012
(wikipedia)

More people → More shipments of goods → More packaging opportunities

http://upload.wikimedia.org/wikipedia/commons/0/09/MXPopgrowth.jpg
Leon, Mexico

- Metropolitan area has about 2.1M people (2010)
- The seventh most populous metropolitan area in Mexico
- Strong leather industry. 60% of the shoes produced in Mexico are made in Leon.
- There are also chemical industry, plastic, polymer, box companies, and automotive industries.
- Major distribution center with rail container yard
- Considered the “Capital” for Social, Commercial and Government Services

www.wikipedia.org
Universidad La Salle

- 15 campuses in Mexico
- Leon Campus
  - School of Engineering
    - Industrial Engineering (Logistics)
    - Mechatronics
      (Electrical/Mechanical/Controls/Computer)
  - School of Design
    - Industrial Design
  - School of Communications & Marketing
    - Graphics Design

www.wikipedia.org
MISSION

Inspired by the lasallian’s Community, Service and Faith Inheritance

The mission of the University De La Salle Bajio is the person’s global education.
Quality of Education

- Academic Excellence Institution

  - Three times accredited for assuring the academic and educative quality and training we give to our students, two of them with “Lisa y Llana”.

- In 2009, we received the medal “The World of Armando Olivares”, making Universidad De La Salle the first private university in our state to be awarded it for our outstanding work in three key areas: completion rate, educational quality and social impact.

- We have belonged to the 50 most innovative companies in technology for five consecutive years, this permanence has given us the “Award for Innovation Culture”.

Campus Campestre

7,500 Students

- Professional Associate degrees
- Bachelor degrees
- Continuing Education
- Master degrees
Architecture and Design
- Architecture
- Graphic Design
- Fashion and Footwear Design
- Industrial Design
- **Space and Environmental Design**

Business Administration
- Marketing

Biology
- Production Agricultural Engineer
- Veterinary
- Dentistry

Engineering and Technology
- Electronics and Telecommunication Engineering
- Software Engineering and Computer Systems
- Technology Engineering and Business Solutions
- Biomedical Engineering
- Electromechanical Engineering
- Industrial Engineering
- Civil Engineering

Social sciences and Humanities
- Communication
- Law
- Criminology and Criminalistics
- Education
- Human Capital Development
- Modern Languages and Interculturality
- Psychology
MASTER DEGREE IN DESIGN AND IN MECHATRONIC SYSTEM ENGINEERING

Expertise in:
• Advanced Math and Mechanical Calculus
• Mechanical design and Computer Assisted Simulation
• Industrial Robotics
• Analog, Digital and Power Electronics, Pneumatic and Industrial Electropneumatics

No. Of students:
• Currently 15 • 60 Graduates.

• Industrial Control
• Sensors and Industrial Actuators
• Information Systems
• Data Acquisition Systems through WEB applications
• Databases
• Project Management
• Innovation and Technological Development Methodology

MASTER IN ADMINISTRATIVE AND QUALITY ENGINEERING

Expertise in:
• Quality Management
• Operation Management
• Statistical techniques for process control and analysis
• Fundamentals of labor and tax legislation
• Project Management
• Leadership styles and Professional Ethics

No. Of Students:
• Currently 149 • More than 400 Graduates.
MASTER DEGREE IN MANUFACTURE

Development of professionals who design processes, tools and manufacturing systems, through applying strategies and cutting edge technologies of manufacture engineering, to increase competitiveness within organizations.

Expertise in:

• Strategic planning applied to the development of new products, materials, machinery and manufacturing processes.
• Plant engineering focused on economic feasibility studies and manufacture processes relevance.
• Manufacture Engineering.
• Production and operation of high-tech equipment.

Students:

• Currently
• Graduates

• CNC machines and industrial robots.
• Automated manufacture processes.
• Quality control applied to manufacture processes and products.
• Technological development.
• Management manufacture Projects
**INDUSTRIAL ENGINEERING**

**Expertise in:**
- Design and measurement of work systems
- Analysis and design of facilities
- Maintenance Management
- Planning and Production control
- Optimization and Simulation
- Project Management
- Quality systems and tools
- Quality Engineering

**No. Of students:**
- Currently 240
- 70 graduates per year

**INDUSTRIAL DESIGN**

**Expertise in:**
- Design
- Representation Techniques
- Industrial Technology
- Administration
- Marketing
- Methodology
- History
- Aesthetic appreciation

**Students:**
- Currently
- Graduates
Expertise in:

MARKETING

• Marketing Trends
• Sales Strategies and Loyalty
• Brand creation
• Distribution Channels and Promotion
• Advertising with media optimization
• Public Relations
• Oral and Written Communication
• Qualitative and Quantitative Market studies

Students:

• Currently • Graduates.

Expertise in:

COMMUNICATION SCIENCES

• Advanced Drafting
• Narrative Analysis
• discourse and hermeneutics
• Journalistic genres
• Electronic Journalism
• Audiovisual language
• Radio Language
• TV Language
• Theater Language

Students:

• Currently • Graduates.

• Segmentation for decision making
• Administration
• Strategic Planning
• Costs
• Statistics
• Information Technology
• Financial Marketing
• Consumer Behavior

• Film Language
• CyberLanguage
• Qualitative and quantitative research methods
• Phenomenology
• Depth interview techniques
• Focus Groups
• Semantic analysis
• Analysis and interpretation, Discussion and reconceptualization
• Exposure and Publishing
Infrastructure

- Practice Unit and Workshops
- Design Workshops
- Computer Center
- Broadcasting Center
- Chemical-Biological Labs
- Library
- Dental Clinics
- Oral Trial Chamber
- Gastronomy Practice Unit
- Community’s Human Development Center
- Agricultural Experimental Station

Practice Unit and Workshops

- Industrial Engineering Lab
- Physics, Electricity and Electrical Metrology Lab
- Combustion Workshop
- Hydraulic, Thermo fluids and Sanitary Workshop
- Soil Mechanics and Materials Lab
- Topography
- Metal-Mechanics Lab

- Electronics Lab
- Interface Lab
- Network Lab
- Software Development Lab
- Printed Circuit Lab
- Faraday Cage
- Media and broadcasting Lab
Design Workshops

- Pattern making and sewing workshop
- Airbrush Workshop
- Silkscreen Workshop
- Industrial Woodworking Workshop
- Plastic, Sculpture, Ceramics and Footwear Workshops
- Rapid prototyping machine

Computer Centers

- 2 lounges with Macintosh computers
- Screening room
- Faculty room
- 10 different sized computer rooms PC equipped for up to 60 students
- TV Studio
- 5 digital audio editing booths
- 5 digital video editing booths
- 3 photo studios with digital lighting equipment
- Photo lab with developing and printing center and Darkroom

- Amphitheater
- Entomology Lab
- Herbarium
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- Food Science lab
- Crop Development lab
- Multipurpose Labs
- Greenhouse
- Small species hospital
- Universal Comparison microscope
Library

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New I-9 Form Required

The U.S. Citizenship and Immigration Services (USCIS) announced the release of a revised Form I-9, Employment Eligibility Verification Form. The new form is available now and USCIS is encouraging immediate use. The form must be used starting May 7, 2010.

After May 7, employers who fail to use the revised Form I-9 may be subject to penalties. Employers should follow the instructions found on the new Form I-9 until the release of the revised M-274, Handbook for Employers, which is being updated to conform to the new form.

http://www.palletcentral.com/
March 26, 2013

Dear Pallet End User:

I am delighted to be joining you at the Healthcare Packaging Consortium on Friday, April 19 in Memphis as a guest of Michael Doyle. I am the sales director for the National Wooden Pallet and Container Association (NWPCA), which represents the largest group of wood packaging professionals in the world. Our membership includes more than 620 companies that manufacture, repair and distribute pallets, containers and reels, or that supply products and services to the industry.

As part of the consortium, NWPCA software developer John McLeod will introduce and demonstrate our Pallet Design System© (PDS) software which has been the industry standard in pallet design for nearly 30 years. PDS is now available for pallet users to lease, and pallet users are a growing and valued part of our membership. It is particularly exciting to present the newest version of the software which enables PDS users to factor in the specific unit load handling requirements of the pallet – including containers, load stabilizers and stacking patterns – in order to design the most practical, efficient, economical and structurally-sound unit load.

I look forward to speaking with you about NWPCA and PDS after you have had the opportunity to see the capabilities of this incredible unit load design and analysis tool. Please feel free to contact me with any questions at 703-519-6104 and again, I look forward to meeting you on April 19.

Sincerely,

Joni Leonardo
Sales Director, NWPCA
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