EXPRESS SHIPPING DROP/IMPACT STUDY IN CENTRAL AND EASTERN EUROPE

A Joint Project Between Hewlett-Packard, ISTA and SCA Packaging Europe

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Acknowledgement

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Supply Chain Requirements on a Package

Create value through the supply chain:

- Move the product in a secure way
- Communicate through the supply chain



be seen



be moved



be secure







Move the Product in a Secure Way

- The package has to be designed to give the proper protection while not using too much material
 - Economical and environmental impact

Requirements

- Material knowledge
- Supply chain knowledge









Material Knowledge

- 30-day storage reduces box strength by roughly 50 %
 - High humidity severely reduces the strength of the box





Supply Chain Knowledge



/Source: SRETS - Final Report, Packforsk report No. 189, 1999 /







Supply Chain Research

- Experience
- Information
- Observation
- Measure









Project MADE/CEE

<u>Measurement and Analysis of Distribution Environment in</u> <u>Central and Eastern Europe</u>

- Following EMEA-MADE
- Express carriers in Eastern Europe
- Focus on drop and impact
- ISTA testing standards







Routing Map - MADE in Europe



Experimental Design of Package

- Dummy product
 - 10,2 kg (22.5 lb.)
 - 432 x 381 x 203 mm (17 x 15 x 8 in.)
- Field Recorder
 - Saver 3X90 from Lansmont Corp.
 - 0,5 kg (1 lb.)
- Cushion Material
 - 8 EPE corners, 50mm thick (2 in.)
- Box
 - Double Wall Corrugated Board (BC)
 - KN186-RF140-RF140-RF140-KN186
 - 534 x 483 x 305 mm (21 x 19 x 12 in.)
- Total weight 13,2 kg (29 lb.)

















Experimental Shipping

- 2 Identical Packages
- Express Carriers
 - UPS, DHL, Schenker
- Destinations
 - Budapest in Hungary
 - Poznan in Poland
 - Pardubice in Czech- Republic
- 40 Single Trips
 - November 2005 to October 2006







Experimental Shipping

- Package
 - Replaced every 3rd or 6th shipment + when needed
- Data
 - Downloaded after each trip to e-room or sent by CD
 - Restarted with onboard setting
- Tracking information
 - Tracking number documented
 - Summary documentation available







Data and Results

Analyzed Recorder Data as EFFDH

40 one-way trips, 472 "significant" events

Identified Highest Drops per Trip

For this study, 4 highest drops per trip

For Each Rank of Per Trip EFFDH

- Fit data to a statistical distribution, analyzed distributions at 95th percentile
- Number of Drops/Impacts per Trip
- Tabulated Impact Orientations
- Compared With Data from Western Europe







Recorder Data Analyzed as EFFDH

- In the lab, we simulate <u>all</u> of this environment's shock events with free-fall drops
- It makes sense to analyze the data in the way it will be used
 - Requires a calibrated package to characterize e (coefficient of restitution)
 - Calculated event velocity change, then applied e to obtain impact velocity
 - Used appropriate combinations of recorder's "zero-g" information and impact velocity calculations to arrive at EFFDH







Highest Drops per Trip







File	Total No. of Recorded Events	No. of Drops/Impacts at or Above 6"	Highest Drop/Impact from Ea. Trip	2nd Highest Drop/Impact from Ea. Trip	3rd Highest Drop/Impact from Ea. Trip	4th Highest Drop/Impact from Ea. Trip
CZ-HU-1	88	7	16	11	10	10
CZ-HU-3	24	5	28	16	15	12
CZ-HU-4	297	15	28	26	24	17
CZ-HU-5	199	15	21	18	17	17
CZ-HU-7	154	10	23	22	17	15
CZ-PL-1	219	8	28	11	10	9
CZ-PL-3	134	7	14	12	12	9
CZ-PL-4	45	11	24	21	20	17
CZ-PL-5	67	6	13	12	11	11
CZ-PL-6	187	6	23	21	8	8
CZ-PL-7	586	9	27	20	14	14
CZ-PL-8	427	9	16	15	15	15
HU-CZ-1	341	21	22	19	18	17
HU-CZ-2	204	10	21	17	15	14
HU-CZ-3	199	15	29	23	19	17
HU-CZ-4	30	10	18	17	14	13
HU-CZ-5	39	9	18	17	16	14
HU-CZ-6	91	14	18	16	14	13
HU-CZ-7	922	11	25	18	18	14
HU-CZ-9	675	12	24	17	15	15
HU-PL-1	264	14	18	17	15	14
HU-PL-2	184	19	28	22	21	20
HU-PL-3	44	10	17	14	14	13
HU-PL-4	177	12	26	20	18	18
HU-PL-5	449	15	32	21	21	16
HU-PL-6	187	9	20	20	15	11
HU-PL-8	148	14	24	20	20	17
PL-CZ-1	544	15	32	23	15	15
PL-CZ-2	26	11	19	19	13	12
PL-CZ-3	32	12	20	16	14	14
PL-CZ-4	133	5	11	10	8	7
PL-CZ-5	162	10	19	16	15	13
PL-CZ-6	198	17	10	12	11	11
PL-HU-1	147	21	43	16	14	12
PL-HU-2	180	18	24	16	15	13
PL-HU-3	36	11	20	18	18	17
PL-HU-4	33	10	22	16	10	8
PL-HU-5	191	15	25	18	17	17
PL-HU-7	1675	15	20	19	15	11
PL-HU-8	1801	9	29	16	15	11





Statistical Analysis

- Fit Data to Statistical Distributions
- Analyzed Distributions at 95th Percentile
 - Highest EFFDH
 - Fit a log-normal distribution, 95th percentile EFFDH = 37.1 inches
 - 2nd-Highest EFFDH
 - Fit a log-normal distribution, 95th percentile **EFFDH = 26. 3 inches**
 - 3rd-Highest EFFDH
 - Fit a normal distribution, 95th percentile EFFDH = 22.1 inches
 - 4th-Highest EFFDH
 - Fit a log-normal distribution, 95th percentile EFFDH = 21.3 inches
 - Number of Drops/Impacts per Trip
 - Fit a normal distribution, 95th percentile <u>Drops/Impacts = 19.8</u>







Impact Orientations

Obtained directly from recorder's software

- Flat-face impacts <u>22% of the total</u>
- Edge impacts <u>46% of the total</u>
- Corner impacts <u>32% of the total</u>
- Impacts on and around the bottom of the package (bottom face, bottom edges and corners) – <u>71%</u>
- Impacts on and around the top of the package (top face, top edges and corners) – <u>14%</u>
- Flat vertical-face impacts <u>6%</u>
- Vertical edge impacts <u>9%</u>







Comparison With Western Europe EFFDH & Number of Events

	Highest EFFDH	2nd Highest EFFDH	3rd Highest EFFDH	4th Highest EFFDH	No. of Drops/Impacts per Shipment
Western Europe	31.6 in. (80.3 cm)	25.7 in. (65.3 cm)	23.4 in. (59.4 cm)	20.7 in. (52.6 cm)	17
Central/Eastern Europe	37.1 in. (94.2 cm)	26.3 in. (66.8 cm)	22.1 in. (56.1 cm)	21.3 in. (54.1 cm)	20
Differences	5.5 in.	0.6 in.	1.3 in.	0.6 in.	3 Events

Are the results statistically different? Must consider data *variability*















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Comparison With Western Europe Impact Orientations

	Flat	Edge	Corner	o/a Bottom	o/a Top	Vertical Flat Face	Vertical Edge
Western Europe	21%	51%	28%	52%	22%	12%	14%
Central/- Eastern Europe	22%	46%	32%	71%	14%	6%	9%

Could field observation explain the differences?

???

Similar







Conclusions

- Drop/Impact Data From Central & Eastern Europe is Quite Similar to Data From Western Europe
 - Maybe the highest EFFDH is somewhat higher, and there are a few more events per trip
- Impact Orientations Are Somewhat Different
 - More impacts o/a bottom of package in CEE
- Drop Tests in ISTA 3A Look Reasonable For Europe As Well As the U.S.







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