ecoflo
from GREENLIGHT PACKAGING

Comparative Performance Testing of Commercially Available Loose Fill

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1. Test requirements

1.1. The Objectives of the Tests

Transit tests - to compare degree of goods migration for relatively heavy goods during transport between seven different types of commercially available loosefill products.

1.2 Materials and goods protected in the tests.

The loosefill materials tested are as listed in Table 1.
The outer packaging was a corrugated carton box (transit carton). The inner dimensions are shown in Table 2.
The goods protected by the packaging were a corrugated carton box filled with sand sealed in a plastic bag. The dimension and mass of the box containing sand are shown in Table 3.

Table 1. Bulk Density of eight types of loosefills

No.	Loosefill Product	Bulk Density(kg/m^3)
1	GreenFill	7.60
3	EcoFlo	8.20
4	Renature	11.40
5	Flopak	4.80
6	Styrofil	4.10
7	Alta-ess	6.00
8	Spacepack	4.30

Table 2. Inner dimension of the carton boxes

Length (mm)	Width (mm)	Height (mm)
370	325	242

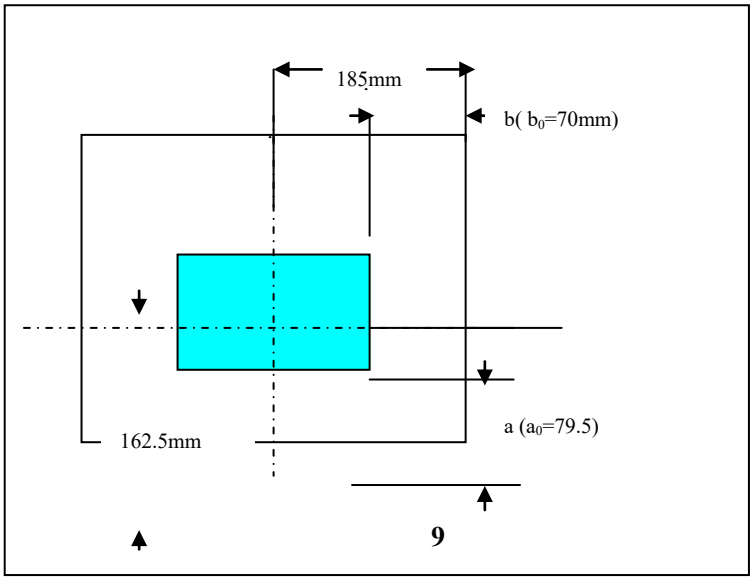
Table 3. Dimensions and mass of the goods packed

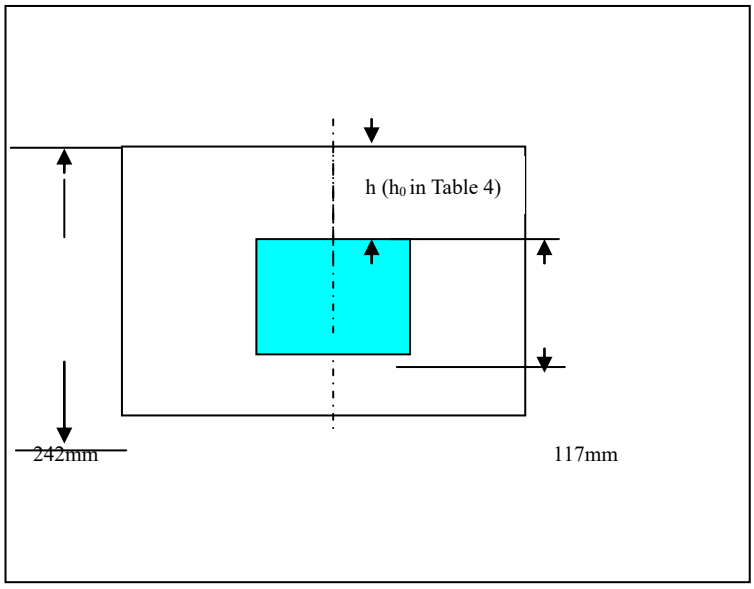
Length (mm)	Width (mm)	Height (mm)	Mass (kg)
230	166	117	4

2. Descriptions of the tests

2.1 Packaging preparation

A fixed volume of 16 litres of loose fill (the cushioning materials) was filled into the transit carton. The transit carton was shaken twice manually to level and pack the loose fill. Then the packed sand was positioned be in the centre within the transit carton as shown schematically in Fig.1, where a_0 and b_0 are the reference horizontal positions of the goods.





The distance h_0 (shown schematically in Fig 2) was then recorded as the reference vertical position for each loosefill.
The rest of the space in the box was then filled up. An extra 7% of the void volume, ie a 7% overfill of the loosefill was used to provide some initial compaction during packing.
The boxes were then sealed with packaging tape.
The above was performed in duplicate ie two boxes were used to pack the goods using each loosefill material as described above. Thus a total of 14 boxes were prepared. They were used to transit tests and the data reported below are from the average of two samples for each material.

2.2 The transit tests:

The packed boxes were then loaded on a van on a 3-day trip of a total 1100 miles travelling at an average speed of 45 mile/hour.

3. Results

3.1. Goods migration

The distances a and b (shown in Fig.1) and h (shown in Fig.2) after the transit test were measured and listed as in Table 4 together with the displacements relative to the reference positions.

Table 4 Overall goods migration after transit

No.	Loosefill Product	a(mm)	a(mm)	b(mm)	b(mm)	h(mm)	h_0(mm)	h(mm)
1	Greenfill	83	3.5	57	-13	92	54	38
2	Ecoflo	88	8.5	65	-5	67	49	18
3	Flopak Super	75	-4.5	55	-15	86	52	34
4	Renature	83	3.5	68	-2	67	47	20
5	Alta-ess	74	-5.5	59	-11	59	43	16
6	Styrofil	85	5.5	79	9	101	62	39
7	Spacepack	81	1.5	61	-9	61	43	18

Notes:
The original distance a_0 is 79.5mm. b_0 is 70mm .
$a = a - a_0$
$b = b - b_0$
$h = h - h_0$

The degree of horizontal migration of the goods after the transit test is summarized in Table 5. Small horizontal migration of around 10% or less was considered as negligible for loosefill packaging.

Table 5. Ranking of loose fill in terms of the degree of horizontal migration.

No.	Loosfill Product	a/a_0 (%)	b/b_0 (%)	Horizontal displacement ($a/a_0 + b/b_0$)/2(%)
1	Renature	4.4	2.9	3.7
2	Spacepack	1.9	12.9	7.4
3	Ecoflo	10.7	7.1	8.9
4	Styrofil	6.9	12.9	9.9
5	Alta-ess	6.9	15.7	11.3
6	Greenfill	4.4	18.6	11.5
7	Flopak Super	5.7	21.4	13.6

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The degree of vertical migration of the goods after the transit test is summarized in Table 6. The vertical migrations are relatively much higher than those of horizontal migration. This is due, in part, to the rearrangement of loosefill but more to the compaction of loosefill by the weight of goods during transport. The static compressive stress beneath the goods was about 1kPa but the additional stress resulted from the dynamic loading during transport should also be taken into account. The test conditions used here were quite harsh for loosefill packaging: high compressive stress level (over 1kPa) and a transport journey over 1000 miles. Yet the first three loosefill in Table 6 retained over 75% of the original cushion thickness beneath the goods to protect impact or drop.

Table 6.
Ranking of the loose fill in terms of the degree of vertical migration

No.	Loosefill Product	Vertical migration	
		h(mm)	h/h_0 (%)
1	EcoFlo	18	36.7
2	Alta-ess	16	37.2
3	Spacepack	18	41.9
4	Renature	20	42.6
5	Styrofil	39	62.9
6	Flopak Super	34	65.4
7	Greenfill	38	70.4

4. Summary statement

EcoFlo performed well compared with the other loosefill in the packaging of relatively heavy goods (under static compression of 1 kPa) being 3rd and 1st in horizontal and vertical ranking respectively. EcoFlo performance was most similar to Spacepack and Alta-ess. GreenFill was less suitable for heavy objects and performed more like Flopak.

With regards to loosefill usage levels it can be seen that exactly the same volume of loosefill was used to pack each box. ***No damage was observed in any test.***