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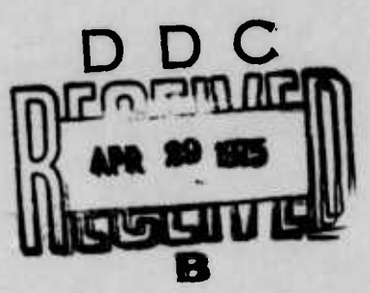

EVALUATION OF "PACKCREST" #1008

CUSHIONING MATERIAL

HQ AFLC/DSP
AIR FORCE PACKAGING EVALUATION AGENCY
Wright-Patterson AFB OH 45433

April 1975

NOTICE

ABSTRACT

A new cushioning material concept, involving the combination of polystyrene "beads" with a matrix of polyurethane foam was evaluated to determine whether the union of these two materials would provide any synergistic benefits. The shock absorbing properties of the material was evaluated using standard dynamic cushioning tests. The test data, plotted in the form of Peak Acceleration versus Static Stress curves was compared with conventional polyurethane and polystyrene cushioning materials. The test results indicated that no significant improvement in shock absorbing properties was achieved by the combination of the two materials.

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INTRODUCTION.

The material evaluated, "Packcrest" #1008, was manufactured by the Crest Foam Corporation. It is formed by mixing unexpanded polystyrene "beads" with polyurethane components during the foaming process. The heat and moisture associated with the foaming reaction results in the partial expansion of the polystyrene "beads" dispersed throughout the polyurethane matrix. It was expected that there would be some synergistic benefit from the combination of these two materials.

OBJECTIVE.

The objective of this study was to develop Peak-G versus Static Stress curves for the material using the test method specified in ASTM D-1596-59T, and compare the results with existing cushioning materials for cost effectiveness.

SPECIMEN.

The 8" X 8" samples were furnished in 2-inch and 4-inch thicknesses. The density of both thicknesses was 2.5 lb/ft^3. The material was green with various sizes of "beads" of white polystyrene dispersed throughout the material.

TEST EQUIPMENT.

A Hardigg Cushion Tester, model #3, was used to develop the Peak-G versus Static Stress curves. Acceleration values were measured and recorded using both an "Endevco" crystal accelerometer, model 2233E, and a "Statham" strain gauge accelerometer, type A5A-100-350, with a Tektronix oscilloscope.

TEST PROCEDURE.

The 2-inch thick specimens were evaluated using platen drop heights of 24 and 30 inches while the 4-inch thick specimens were subjected to drop heights of 24 and 36 inches.

Three specimens were used for each static stress point (platen weight). The first drop on each specimen was ignored and the other four drops were averaged to give a 12 drop average for three specimen for each point.

RESULTS.

The results of the drop tests are presented in graphs 1 through 4. The material performed well during testing and had less than 10% set at the completion of testing. For comparison purposes, Peak-G versus Static Stress curves for polystyrene (1.5 lb/ft^3) and polyurethane ether (2 and 4 lb/ft^3) were included in the graphs. These curves were extracted from MIL-HDBK-304A.

DISCUSSION.

By comparing the developed Peak-G versus Static Stress data with existing data for polyurethane and polystyrene materials, it appears that there has been no synergistic benefit from the combination of the two materials. By looking at graphs 1 through 4, it can be seen that in every case, the 2 lb/ft^3 polyurethane (ether), outperforms the "Packcrest" material in the low static stress regions (0.03 to 0.25 psi) and the 1.5 lb/ft^3 polystyrene outperforms the "Packcrest" at the higher static stress regions (0.5 to 1.0 psi).

One way to determine the cost effectiveness of a material is to evaluate the cost of equivalent shock protection for a given item packaged in various materials. The cost of shipping and other variables can be included. This was done, using the Packaging Design Program contained in the CREATE computer system.

The materials were evaluated at three static stress points (0.1, 0.4, and 0.6 psi) using fragility levels of 44, 50, and 60 Gs respectively for a drop height of 36 inches. The item size to be packaged was selected as a 12-inch cube and was to be completely encapsulated. The exterior container was single wall V3c fiberboard and the container was to be shipped 2000 miles by Logair.

The results of some of the most cost effective materials can be seen in Table I. It can be seen that the "Packcrest" material is most cost competitive at the 0.4 psi static stress point.

CONCLUSIONS.

From the cost analysis mentioned above, the following conclusions can be drawn:

1. "Packcrest" 1008 cushioning material is not cost competitive in the low static stress range (0.04 to 0.25 psi).

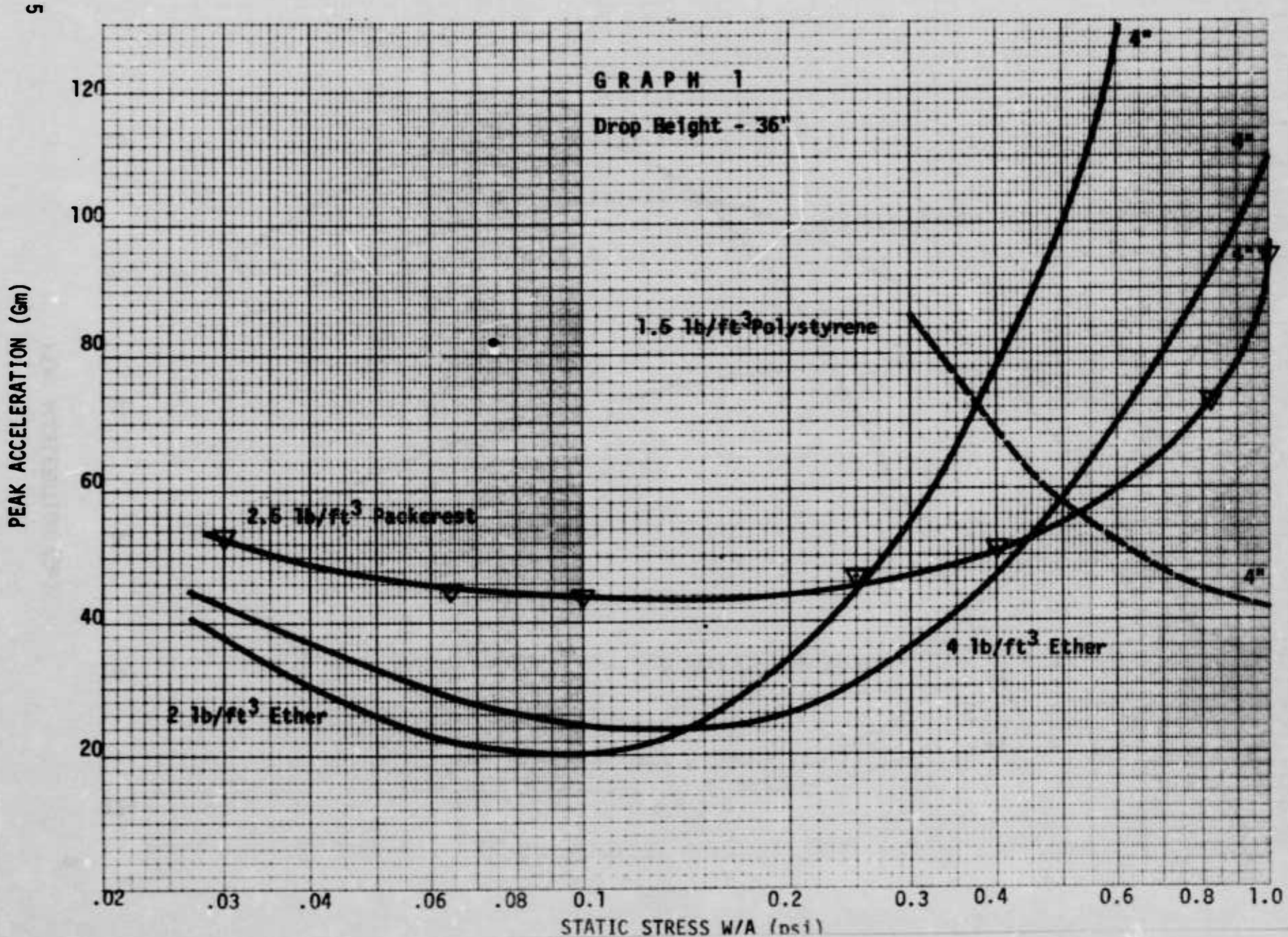
2. "Packcrest" 1008 would be most cost competitive in a narrow stress range centered about a static loading stress of 0.4 psi.

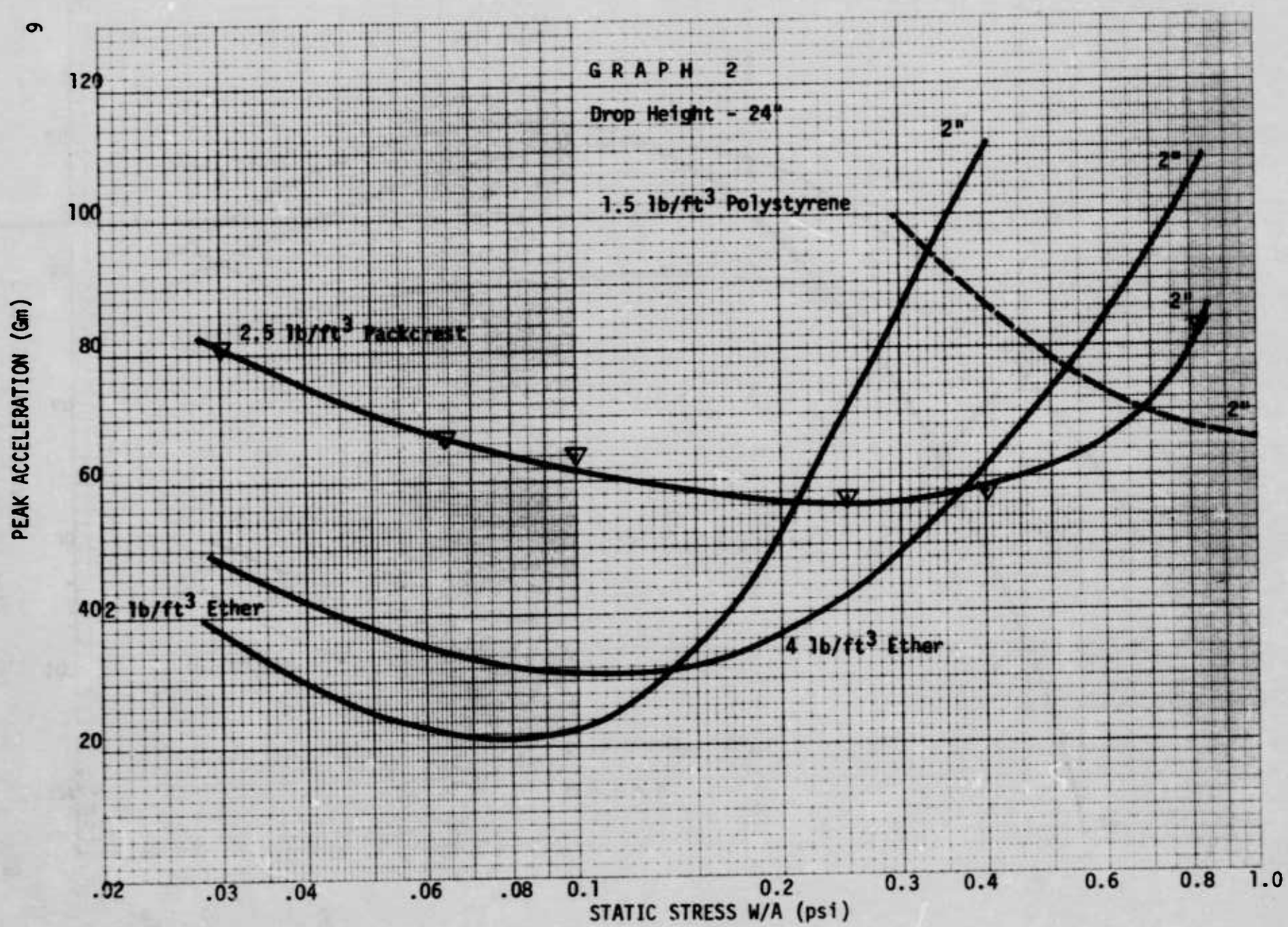
TABLE 1

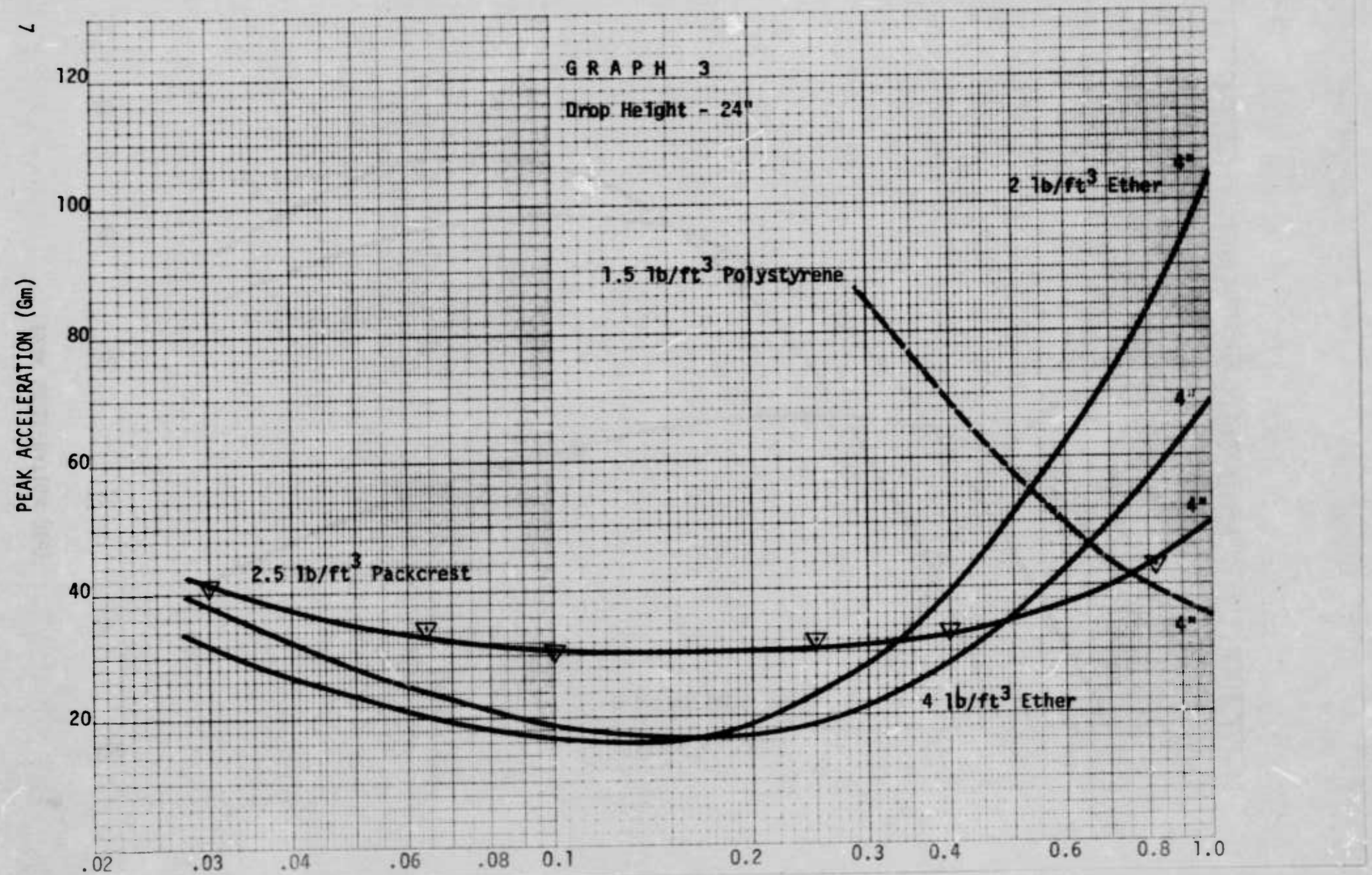
Item Size - 12" X 12" X 12"
Drop Height - 36"

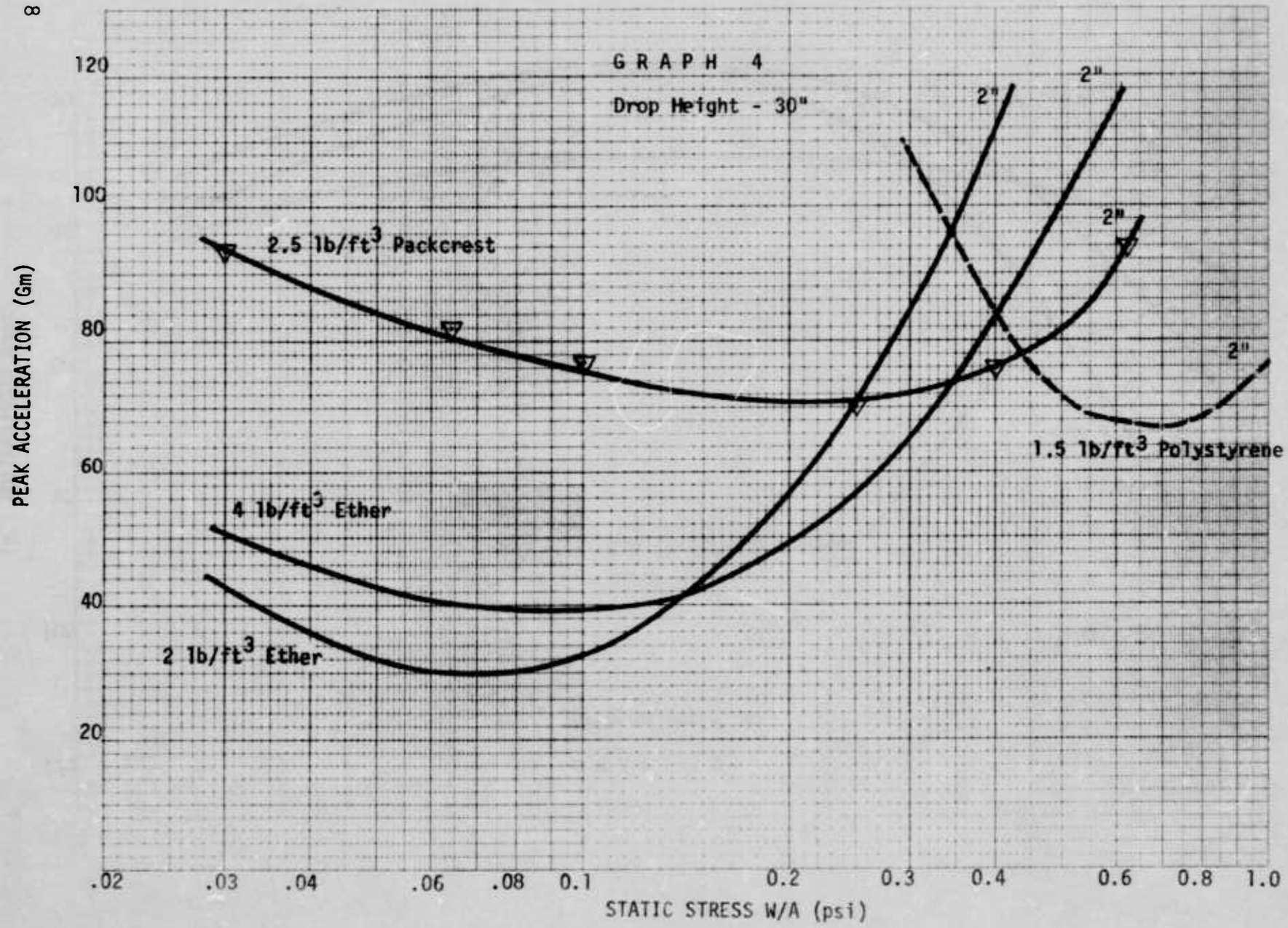
LOGAIR - 2000 Miles

Fragility (Gs)	Static Stress (psi)	Type Material	Mat Thick	Cush Mat Cost	Container Size	Container Cost	Cush Wt(lb)	Total (Wt(lb)	Shipping Cost	Total Cost
44	0.10	2.5 lb/ft^3 Packcrest	4"	$9.58	20X20X20	$1.98	9.1	27.19	$5.43	$17.59
		2 lb/ft^3 Polyurethane(ether)	2	2.30	16X16X16	1.34	2.74	19.49	3.90	8.06
		1.5 lb/ft^3 Polyurethane(ether)	2.5	2.43	17X17X17	1.49	2.76	19.81	3.96	8.45
		Type III Rubberized Hair	3	3.00	18X18X18	1.64	3.80	20.93	4.19	9.45
50	0.4	2.5 lb/ft^3 Packcrest	4	9.58	20X20X20	1.98	9.1	70.39	14.07	26.23
		2 lb/ft^3 Polyethylene	3	9.94	18X18X18	1.64	4.75	65.32	13.06	25.26
		1.5 lb/ft^3 Polyurethane(ester)	3.5	6.41	19X19X19	1.81	4.45	65.36	13.07	21.96
		4 lb/ft^3 Polyurethane(ether)	4	7.84	20X20X20	1.98	14.52	75.79	15.16	25.58
		4 lb/ft^3 Polyethylene	3.5	16.93	19X19X19	1.81	11.87	72.7	14.56	33.96
60	0.6	2.5 lb/ft^3 Packcrest	4	9.58	20X20X20	1.98	9.1	99.19	19.83	31.99
		1.5 lb/ft^3 Polyurethane(ester)	3	5.13	18X18X18	1.64	3.56	92.9	18.59	25.97
		1.5 lb/ft^3 Polystyrene	3	3.28	18X18X18	1.64	3.56	92.9	18.59	24.12
		2 lb/ft^3 Polyethylene	2.5	7.71	17X17X17	1.49	3.68	92.7	18.55	28.31
		4 lb/ft^3 Polyurethane(ether)	4.5	9.42	21X21X21	2.16	17.4	107.88	21.58	33.92


GRAPH 1
Drop Height - 36"
PEAK ACCELERATION (Gm)
STATIC STRESS W/A (psi)
120
100
80
60
40
20
.02
.03
.04
.06
.08
0.1
0.2
0.3
0.4
0.6
0.8
1.0
1.6 lb/ft3 Polystyrene
2.5 lb/ft3 Packerest
2 lb/ft3 Ether
4 lb/ft3 Ether
4"
4"
4"


GRAPH 2
Drop Height - 24"
1.5 lb/ft3 Polystyrene
2.5 lb/ft3 Packcrest
2 lb/ft3 Ether
4 lb/ft3 Ether
2"
2"
2"
2"
PEAK ACCELERATION (Gm)
120
100
80
60
40
20
.02
.03
.04
.06
.08
0.1
0.2
0.3
0.4
0.6
0.8
1.0
STATIC STRESS W/A (psi)


GRAPH 3
Drop Height - 24"
PEAK ACCELERATION (Gm)
120
100
80
60
40
20
.02
.03
.04
.06
.08
0.1
0.2
0.3
0.4
0.6
0.8
1.0
2 lb/ft3 Ether
1.5 lb/ft3 Polystyrene
2.5 lb/ft3 Packcrest
4 lb/ft3 Ether
8"
4"
4"
4"


GRAPH 4
Drop Height - 30"
PEAK ACCELERATION (Gm)
120
100
80
60
40
20
2.5 lb/ft3 Packcrest
4 lb/ft3 Ether
2 lb/ft3 Ether
1.5 lb/ft3 Polystyrene
2"
2"
2"
2"
.02
.03
.04
.06
.08
0.1
0.2
0.3
0.4
0.6
0.8
1.0
STATIC STRESS W/A (psi)

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A new cushioning material concept, involving the combination of polystyrene "beads" with a matrix of polyurethane foam was evaluated to determine whether the union of these two materials would provide any synergistic benefits. The shock absorbing properties of the material was evaluated using standard dynamic cushioning tests. The test data, plotted in the form of Peak Acceleration versus Static Stress curves was compared with conventional polyurethane and polystyrene cushioning materials. The test results indicated that no significant improvement in shock absorbing properties was achieved by the combination of the two materials

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