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PACKAGING FOR THE CN-1325/ASN-108 AHRS DISPLACEMENT
GYROSCOPE(U) AIR FORCE PACKAGING EVALUATION AGENCY
WRIGHT-PATTERSON AFB OH MATERIALS ENGINEERING BRANCH

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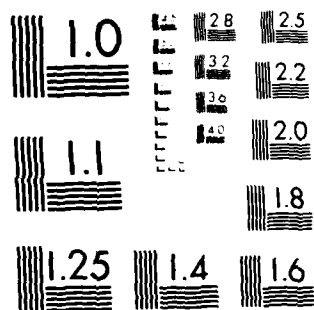
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AFPEA Project No. 83-P7-129

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PACKAGING FOR THE CN-1325/ASN-108
AHRS DISPLACEMENT GYROSCOPE

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AIR FORCE PACKAGING EVALUATION AGENCY
Wright-Patterson AFB OH 45433

November 1983

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AFPEA PROJECT NO.: 83-P7-129

TITLE: Packaging for the CN-1325/ASN-108 AHRS Displacement Gyroscope

PROJECT MONITOR: Mary T. Wyderski

ABSTRACT

The Aerospace Guidance and Metrology Center (AGMC) requested an investigation of a potential packaging deficiency noted in packs for reparable gyroscopes shipped to their center from field units. The corner pads of these packs had shown significant compression as indicated by the 3/4" - 1 1/2" increase in void space above the top corner pads. Evaluation of these packs indicated that the peak acceleration experienced by the gyroscope increases in proportion to the degree of compression set occurring in the corner pads.

An alternative pack design was fabricated and evaluated to determine its ability to protect the gyroscope. Instrumented drop tests indicated the new design would provide adequate protection for this item. It was recommended that the alternative pack design be used to replace the current pack for the CN/ASN gyroscope pack.

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INTRODUCTION

Newark AFS (AGMC) reported a potential damage problem relating to the packaging currently used for the displacement gyroscope, CN-1375/ASN-108 AHRS. Inspection of packs received from field units revealed a significant amount of "set" had occurred in the cushioning system to the extent that a 3/4" - 1 1/2" void had developed in the headspace of the container. Since this amount of cushioning compression "set" could adversely effect the shock protection provided by this pack, AGMC requested an investigation to determine the cause and effect of the "set", and if necessary, the corrective measures that should be taken.

DESCRIPTION OF TEST PACKS/LOAD

A. Current Pack: Three packs were received from AGMC/DMTP, Newark AFS for evaluation. Design details and materials prescribed for these packs are provided in TPO 00-303-6728, (atch 1). These packs are required to protect the CN-1375/ASN-108 AHRS displacement gyroscope, which has a 15G fragility rating.

B. Alternative Pack Design: This pack design utilizes the same inner and outer containers with respect to style and materials, as prescribed by TPO 00-303-6728; however, the outer RSC container is of a different size measuring 27 1/2" x 23 1/2" x 23 3/4" (inside dimensions). Design details are provided in attachment 2 and Figure 1. In contrast to the corner pad cushioning used in the current pack design, the cushioning system in the new pack employs complete encapsulation with convoluted polyurethane foam pads. The pads consist of two layers of convoluted polyurethane foam, bonded together at their flat surfaces with "74 Foam and Fabric" adhesive distributed by 3M Company, (see Figure 2).

C. Test Load: A 12 1/2 pound cylindrical test load, 7" diameter, 8 1/2" length, was constructed of wood and metal sections combined to simulate the weight and form of the actual gyroscope. A cavity was provided at the geometric center of the load to provide for the mounting of accelerometers to measure shock transmitted during the drop test evaluation of the packs.

TEST EQUIPMENT AND INSTRUMENTATION

The following equipment and instrumentation were used to conduct this study:

1. Oscilloscope, 4 channel storage, Tektronix, Model 564-B.
2. Accelerometer, tri-axial, Endevco, Model 2233E.
3. Amplifier (3 each), Endevco, Model 2614C.
4. Power Supply, Endevco, Model 2622C.
5. Gaynes Drop Tester, Model 125.

TEST PROCEDURES/RESULTS:

All three TPO packs were subjected to a 30-inch free fall drop test consisting of five consecutive drops on the bottom face. Each bottom face corner pad in the three test packs experienced significant compression set as a result of this series of drops. A triaxial accelerometer was then mounted at the center of the test load. One TPO pack was subjected to two series of six drops on the bottom face. Results for the first impacts of the two series of drops were 12.2 and 14G's. However, maximum shock values of 20 and 21.4G's were obtained for the two drop series. Results are shown in Table I. The alternative pack, with the 12 1/2 pound test load, was subjected to 30-inch drop tests in accordance with Federal Test Method Standard 101B, Method 5007, Procedure B, (flat face drops). Additional 30-inch drops were also made on two diagonally opposite corners and six edges. Results of these tests are shown in Table II.

DISCUSSION/CONCLUSIONS:

A. It is apparent the TPO 00-303-6728 pack will not provide adequate protection for the CN/ASN gyroscope. The load supporting area of the bottom face corner pads compress and deform significantly after repeated impacting on the bottom face. As a result, the peak acceleration experienced by the pack's contents will exceed the rated fragility of 15G by at least 5G's.

B. The redesigned pack provided 15G protection without any evidence of compression set in the cushion pads. The averages of 13.8G's for flat face drops, 15.2G's for corner drops and 14.8G's for edge drops were considered acceptable based on the rated 15G fragility for the CN/ASN gyroscope.

RECOMMENDATION:

Replace pack (TPO 00-303-6728) presently used to package the CN/ASN gyroscope with the pack design presented in this report. Recommend test and evaluation of this container for utilization with the additional fourteen gyroscopes specified for the current TPO 00-303-6728 pack.

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CORNER BLOCK ②

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" " - 951-5140			
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" " - 017-7756			
" " - 021-3681			

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0	AR	TAP	-	SIZE	4	RE	DR	R
1	AR	TAP	-	SIZE	4	RE	QU	R
2	AR	CUSHION	-	1/4	X	1/2	W	4
3	1	WRAP	-	SIZE	4	RE	QU	R
4	1	CARTON	-	LD	12	X	12	5
5	1	PACK	1	4	8	1	2	5
6	1	CORNER	8	BLOCK	-	1/4	1	5
7	1	CONTAINER	-	LD	24	1/2	1	5

Notes

- 1 MAT'L REQ'TS. FOR PART ②, TO BE: POLYURETHANE FOAM, TYPE-1, CLASS-2, GRADE-C, DENSITY-2.0 LBS. PER CU. FT.
- 2 MAT'L REQ'TS. FOR CARTON ④ TO BE: STYLE RSC TYPE-CF, CLASS-DOMESTIC, VARIETY-SW, GRADE - 200PSI.
- 3 MAT'L REQ'TS. FOR PART ⑥ TO BE: POLYPROPYLENE FOAM, UNICELLULAR, RESILIENT, LOW DENSITY MATERIAL, OR EQUAL.
- 4 2 1/2 IN. CUTS IN PART ②, TO BE: TWO AND ONE HALF (2 1/2) INCHES DEEP FOR SHEAR STRESS.
- 5 ITEM CONFIGURATIONS (PICTURE) WILL VARY.
- 6 APPLY WRAP ⑤, OVER ITEM.
- 7 APPLY SUFFICIENT CUSHIONING ⑥, OVER ITEM, TO PREVENT MOVEMENT WITHIN CARTON ④.
- 8 CENTRALLY LOCATE ITEM INSIDE CARTON ④.

- 9 IN TABLE NO. 1-
GROSS WEIGHT TO BE; 26.50 LBS.
- 10 IN TABLE NO. 1-
GROSS WEIGHT TO BE; 30.50 LBS.
- 11 IN TABLE NO. 1-
GROSS WEIGHT TO BE; _____ LBS.

[illegible]

DESCRIPTION OF ALTERNATIVE PACK DESIGN

A. Outer Shipping Container:

Inside dimensions: 27 1/2" x 23 1/2" x 23 3/4"

Style: RSC

Material: V13C, doublewall, weather-resistant, corrugated fiberboard, (PPP-B-636).

B. Inner Container:

Inside dimensions: 12" x 8" x 8"

Style: RSC

Material: 200 psi, singlewall, domestic, corrugated fiberboard, (PPP-B-636).

C. Cushioning Material:

Outer shipping container: Complete encapsulation with convoluted polyurethane foam, 1.0 - 1.5 lb/ft³ density, meeting requirements of MIL-P-26514, Type I, Class 2, Grade B. Pads are fabricated of two pieces of foam bonded together at the flat faces. (See Figure 2).

Inner container: Complete encapsulation with polypropylene foam, unicellular, resilient, low density (PPP-C-1752).

Dimensions of cushion pads:

	<u>LENGTH</u>	<u>WIDTH</u>	<u>THICKNESS</u>
Top and Bottom	11 3/4"	7 3/4"	1/4"
Side	11 3/4"	7 3/4"	1/4"
Side	11 3/4"	7 1/4"	1/2"
End	7"	7 1/2"	1 1/2"
End	7"	7 1/2"	1 3/4"

D. Other Packaging Materials:

Barrier: MIL-B-131; size as required to wrap around inner container.

Wrap: L-P-378; size as required to wrap around item.

Tape: PPP-T-76; size as required for closure of outer and inner container.

PPP-T-97; size as required for reinforcement of outer container.

ATCH 2

TABLE I - Test Results for Current Pack Design
(Two Drop Series on Bottom Face)

SERIES	DROP NO.	RESULTANT PEAK ACCELERATION (Gs)
1	1	14.0
	2	17.3
	3	18.1
	4	19.0
	5	17.0
	6	20.0
2	1	12.2
	2	*
	3	19.2
	4	21.0
	5	21.4
	6	19.1

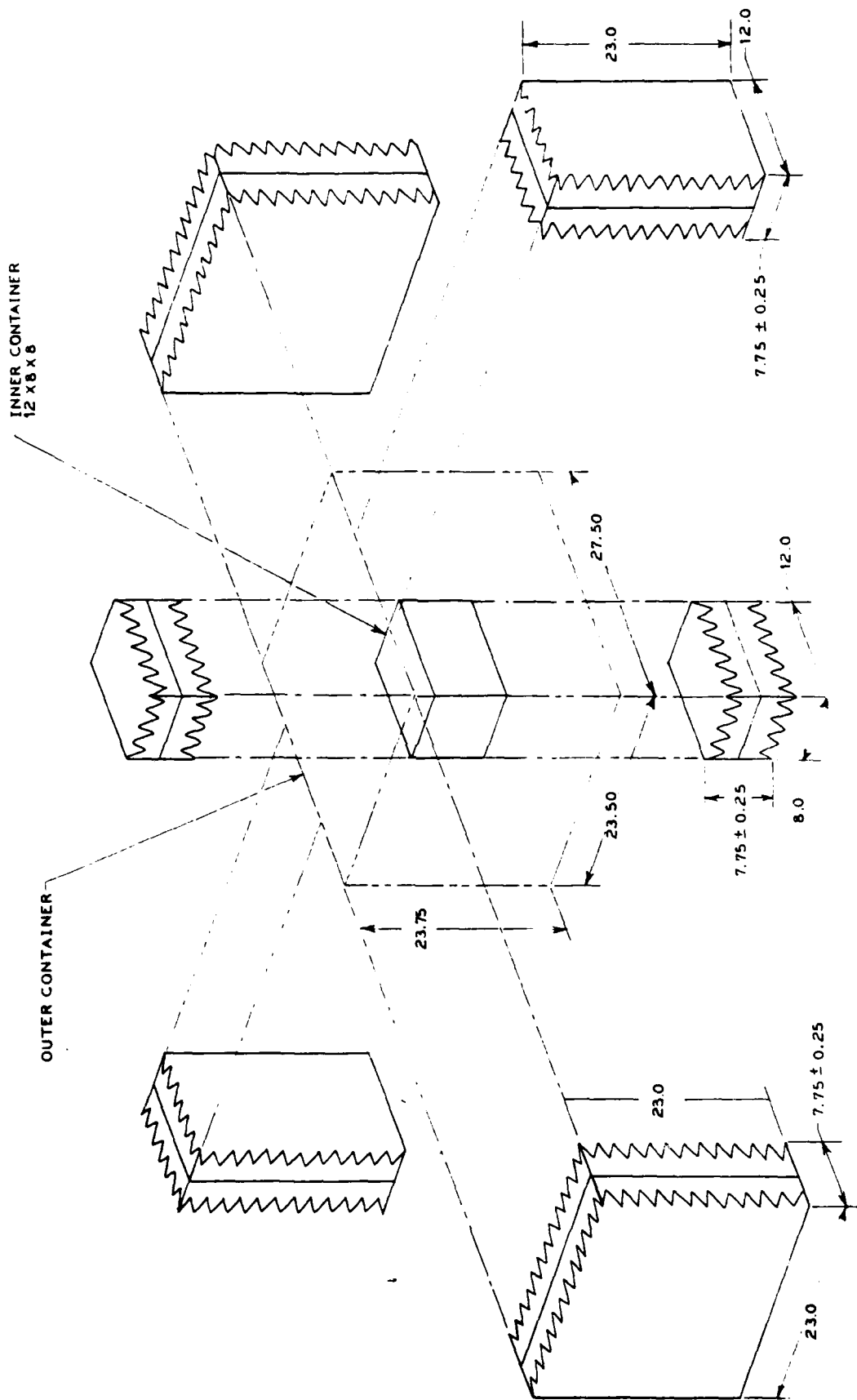
*No value recorded, due to instrumentation failure.

TABLE II - Drop Test Results for
Alternative Design Pack

Impact Face	Impact Corner (Adjacent Faces)	Impact Edge (Adjacent Faces)	Resultant Peak Acceleration (Gs)
3 (Bottom)			12.1
1 (Top)			11.7
2 (Side)			15.2
4 (Side)			12.6
5 (End)			15.8
6 (End)			15.3
	1-2-6		15.6
	3-4-5		14.7
		4-5	15.0
		2-6	14.2
		1-5	13.7
		3-6	13.9
		3-5	15.7
		1-6	16.2

FIGURE 1

Alternative Pack Cushioning System



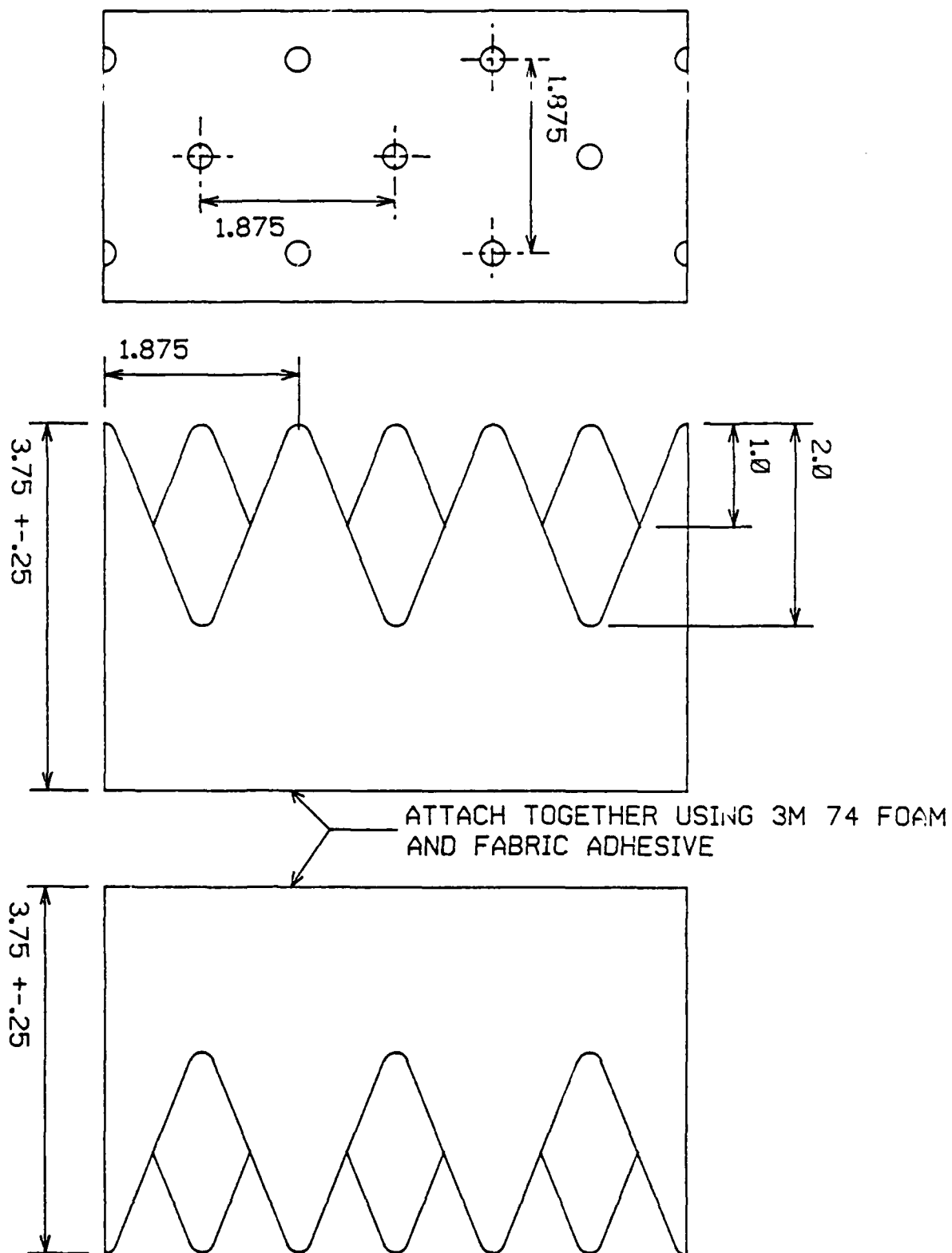


FIGURE 2. CONVOLUTED POLYURETHANE FOAM CUSHION PADS
 DENSITY: 1.3 LB/FT³

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)				
The Aerospace Guidance and Metrology Center has been receiving reparable gyroscopes packaged in TPO 00-303-6828 packs. The load supporting surfaces of the bottom face corner pads have shown significant compression, as indicated by the 3/4" - 1 1/2" increase in void space above the top corner pads. Evaluation of these packs indicated that the peak acceleration experienced by the gyroscope increases in proportion to the degree of compression set occurring in the corner pads. An alternative pack design was fabricated and evaluated to determine its ability to protect the gyroscope. Instrumented drop tests indicated the new design would provide adequate protection for this item. It was recommended that the alternative pack design be used to replace the current pack for the CN/ASN gyroscope.				
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