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PACKAGING AND SHIPPING ANALYSIS OF THE ASN-129 AHRS DISPLACEMENT--ETC(U)  
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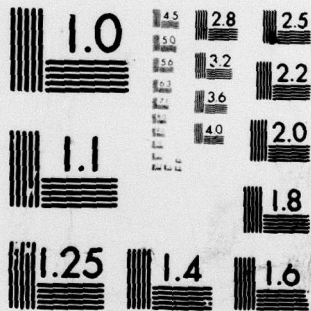


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6 PACKAGING AND SHIPPING ANALYSIS OF THE  
ASN-129 AHRS DISPLACEMENT GYRO

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ABSTRACT

The packaging and shipping analysis of the ASN-129 AHRS Displacement Gyro (A-10 aircraft) revealed that the Transportation Packaging Order pack (TPO 01-021-3681) will not provide the 15 to 20 G shock protection level recommended for this gyro. Field tests confirmed the results of the in-house study.

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## INTRODUCTION

Oklahoma City Air Logistics Center (OC-ALC/DSPA) requested a field test of the A-10 AHRS Displacement Gyro because some of the gyros failed the initial checkout at field level. In-house tests were conducted to supplement the field test data.

## DESCRIPTION OF TEST PACK

The single wall fiberboard outer container included an inner "Fast Pack" (star) container and 2 x 2 inch thick polyurethane (ester) corner pad inserts. The pack dimensions are 16½ L x 16½ W x 23 H inches and it has a gross weight of 23 pounds. The test pack is shown in Figure 1.

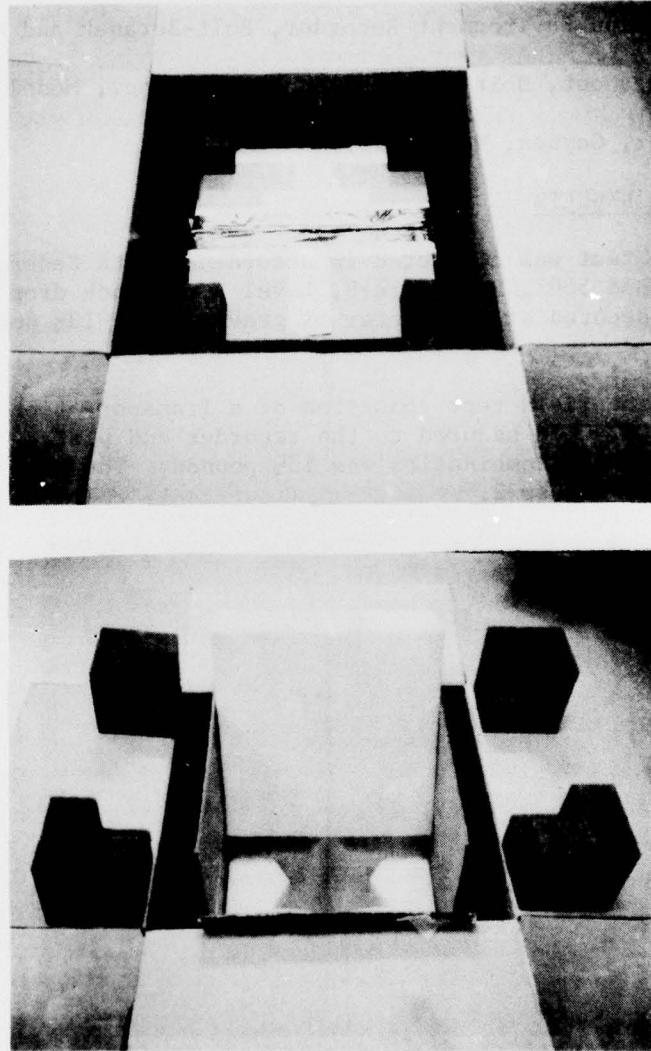


Figure 1. Test Pack

The inner Fast-Pack carton dimensions are 12 x 12 x 18 inches.

## INSTRUMENTATION AND EQUIPMENT

The following instrumentation and equipment were employed for this evaluation:

1. Oscilloscope, Tektronic, 4 channel storage, Model 565B.
2. Accelerometer, tri-axial, Endevco, Model 2233E.
3. Amplifiers (3 ea), Endevco, Model 2424C.
4. Power Supply, Endevco, Model 2622C.
5. Transportation Environment Recorder, Bolt-Beranek and Newman, Model 714.
6. Recorder Readout, Bolt-Beranck and Newman, Inc., Model 615.
7. Drop Tester, Gaynes, Model 125.

## TEST PROCEDURE AND RESULTS

The free fall drop test was conducted in accordance with Federal Test Method Standard 101B, Method 5007, Procedure B, Level A, 30-inch drop height. A tri-axial accelerometer was secured at the center of gravity of a 13½ pound simulated gyro test load.

The test load for the field test consisted of a Transportation Environment Recorder with two pieces of plywood secured to the recorder end plates. The weight for the recorder and plywood combination was 13½ pounds. The test loads are shown in the photograph of Figure 2.

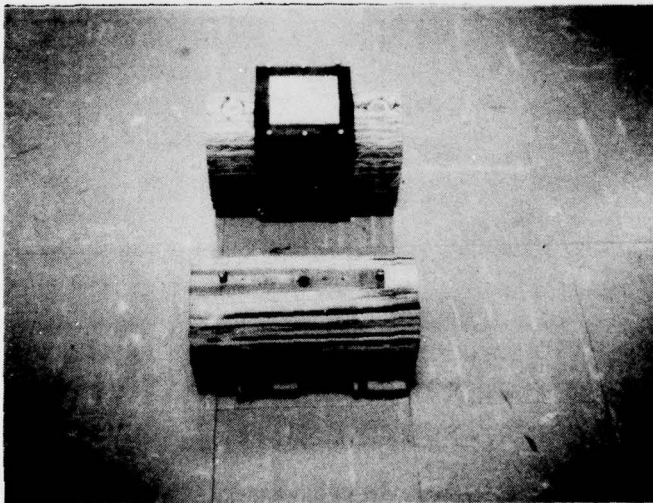


Figure 2. Simulated Gyro Test Loads

The results of the drop tests are listed in Table I and the field test results are presented in Table II. Two series of drop tests were conducted because the

test load rotated within the star pack cavity and positioned itself where the edge of the test load base was adjacent to the thin portion of the star pack cushioning material. This produced the higher shock levels generated during the second drop test series.

IMPACT SURFACE	PEAK ACCELERATION (G)										
	TEST NR. 1					TEST NR 2					
	X	Y	Z	R	Duration Ms	X	Y	Z	R	Duration Ms	
3 (BOT)	15	2	5	15.9	60	16	4	0	16.4	70	
1 (TOP)	12	2	0	12.2	25	10	0	3	10.4	75	
2 (FRONT)	0	2	18	18.1	60	10	44	25	51.6	70	
4 (BACK)	2	2	17	17.2	65	2	17	9	19.3	70	
5 (L. END)	4	30	8	31.3	70	10	28	42	51.5	45	
6 (R. END)	5	21	2	21.7	65	8	12	26	29.7	70	
				AV.	19.4					AV.	29.8

TABLE I, DROP TEST DATA

SHOCK LEVEL RANGE (G)	NUMBER OF SHOCKS RECORDED			
	X	Y	Z	R
2.5-5.0	33	26	46	68
5.0-7.5	8	1	6	21
7.5-10.0	2	3	4	6
10.0-12.5	0	1	1	6
12.5-15.0	0	0	0	2
15.0-17.5	0	0	0	1
17.5-20.0	0	0	0	0
20.0-22.5	0	1	0	0
22.5-25.0	0	0	0	1
TRIP DURATION: 12.9 DAYS				

TABLE II. FIELD TEST DATA

While awaiting the return of the test pack from the field trip, a second test pack was fabricated in the AFPEA shop in accordance with the TPO specifications. The results were similar to the original TPO pack. The average of the shock levels was 25.4 Gs for the first drop test series and 23.9 Gs for the second drop test series.

#### DISCUSSION

In addition to the item rotating within the star pack cavity, another problem occurred when one of the corner pad assemblies became dislodged from the corner resulting in some of the high shock levels recorded during the in-house tests. This Agency's experience with polyurethane corner pads indicates that corner pads with a surface area smaller than 3 x 3 inches will occasionally allow the inner carton to slip between the pad assemblies.

The vertical positioning of the item in the star pack cavity also allowed a "grip effect" to hold the item near the bottom of the cavity, after the initial impact, which reduced the effectiveness of the bottom cushion in subsequent drops. If this gyro and similar gyros are packaged in a horizontal position, the smaller vertical surface area will reduce the "grip effect".

#### CONCLUSIONS

The combination Fast-Pack and 2 x 2 corner pad assemblies will not adequately protect this gyro during rough handling situations.

#### RECOMMENDATIONS

1. Eliminate the inner Fast-Pack and redesign the complete pack.
2. Consider using the Navy's low fragility shipping container (LFSC), ASO P/N 15024-200.

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