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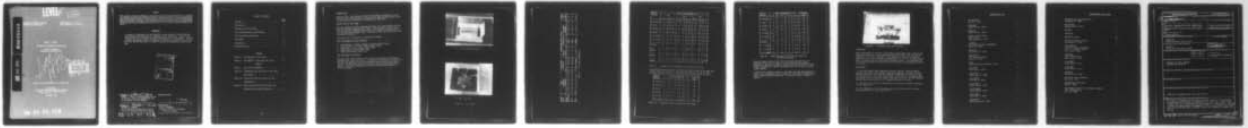
AIR FORCE PACKAGING EVALUATION AGENCY WRIGHT-PATTERSON--ETC F/G 13/4  
ANALYSIS OF PACKAGING FOR THE 7900D GYRO, (U)  
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**ANALYSIS OF PACKAGING FOR THE 7900B GYRO**

**NO AFALD/PTP  
AIR FORCE PACKAGING EVALUATION AGENCY  
Wright-Patterson AFB OH 45433**

**December 1975**

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### ABSTRACT

In support of Oklahoma City Air Logistics Center (OC-ALC), three different pack designs were evaluated for packaging of the 7900D Gyro. Based on performance none of the three packs were considered to be satisfactory. Instead, a corner pad design approach recommended by AFPEA was incorporated by OC-ALC/DSPC with an XA5 Fast Pack to provide a system that adequately protects the gyro.

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## INTRODUCTION

Oklahoma City - Air Logistics Center (OC-ALC/DSPA) requested the evaluation of a Lear Siegler pack, an existing TPO pack and the XA5 Fast Pack to determine those suitable for packaging the 7900D Gyro.

## DESCRIPTION OF TEST PACKS

With the exception of the cushioning material, the Lear Siegler pack and the TPO pack were essentially the same. Both included an inner carton with polyethylene blocking materials and the complete encapsulation of the item with polyurethane foam. This type of pack and the XA5 Fast Pack are shown in figure 1.

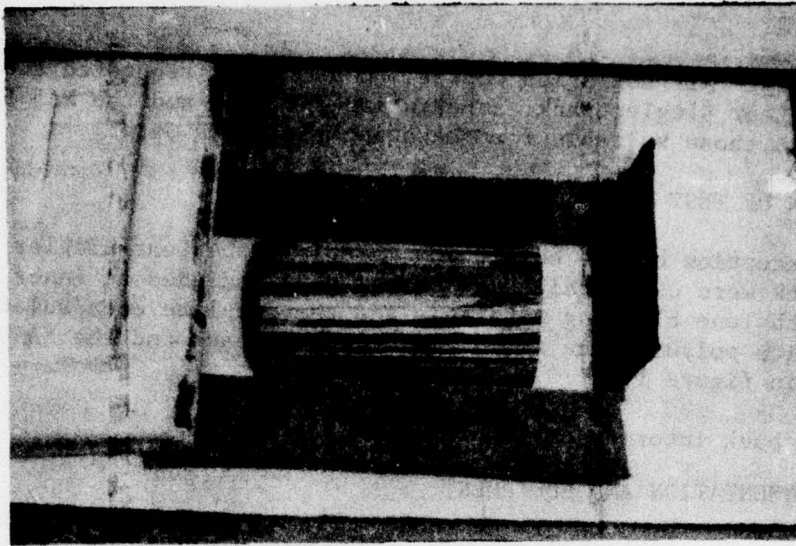
Additional pack information is presented in table I.

## TEST INSTRUMENTATION AND EQUIPMENT

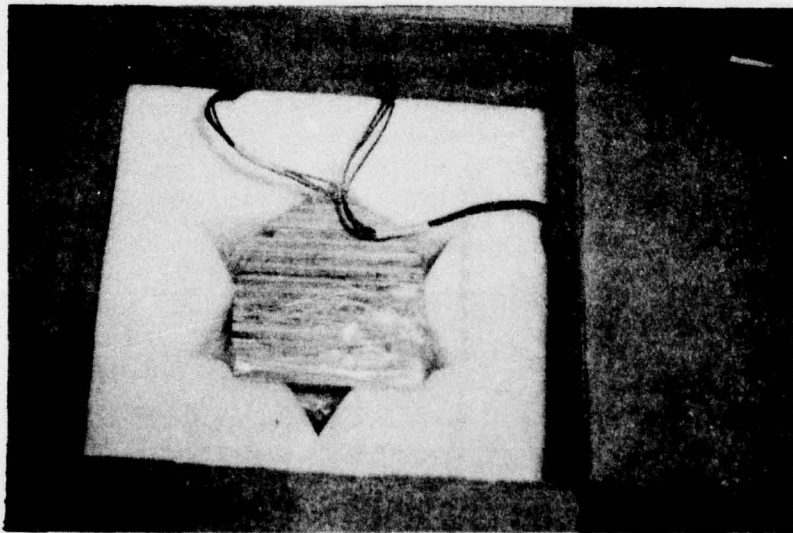
1. Oscilloscope, 4 channel storage, Tektronix Model 564-B
2. Accelerometer, tri-axial, Endevco Model 2233E
3. Amplifiers (3 ea.), Endevco Model 2614C
4. Power Supply, Endevco Model 2622C
5. Gaynes Drop Tester, Model 125

## TEST PROCEDURE AND RESULTS

The drop tests were conducted in accordance with Federal Test Method Standard 101B, except as noted. A tri-axial accelerometer was located at the center of gravity of the wood simulated model to monitor the impact forces. The drop test data for the three test packs are presented in table II. The shock duration for this test series varied from 30 to 50 milliseconds.



a. Lear Siegler/TPO Pack



b. XA5 Fast Pack

Figure 1. Test Packs

TYPE PACK	PACK DIMENSIONS (INCHES)	CONTAINER MATERIAL	CUSHIONING MAT'L. SPEC.		GROSS WT. (LBS.)
			DENSITY (pcf)	FORMULATION	
LEAR SIEGLER	28 5/8 X 18 5/8 X 18 3/8	DW. Fiberbd.	1.1 & 1.3	ETHER	30
TPO	28 5/8 X 18 5/8 X 18 3/8	DW. Fiberbd.	1.2 & 1.4	ETHER	30
XA5	18 X 12 X 12	SW. Fiberbd.	1.75	ETHER 3 & 4	18

Table I. Test Pack Information

IMPACT SURFACE	PEAK ACCELERATION - Gs											
	TPO				LEAR				XA5			
	X	Y	Z	R	X	Y	Z	R	X	Y	Z	R
3 (bottom)	3	8	40	40.9	0	0	16	16.0	0	3	18	18.2
1 (top)	2	4	31	31.3	0	4	15	15.5	3	3	18	18.5
2 (front)	2	29	9	30.4	3	10	3	10.9	0	16	1	16.1
4 (back)	1	28	4	28.3	1	12	2	12.2	2	17	3	17.4
5 (l.side)	17	2	4	17.6	10	1	2	10.2	20	0	2	20.1
6 (r.side)	16	4	4	17.0	10	2	2	10.3	16	2	4	16.6
3 - 4 - 6 (corner)	16	14	11	23.9	10	8	8	15.1	10	8	9	15.7
3 - 4 (edge)	4	26	23	34.9	1	13	13	18.4	1	12	10	15.7
3 - 6 (edge)	20	3	16	25.8	13	0	12	17.7	12	1	8	14.5
4 - 6 (edge)	20	17	4	25.6	11	8	3	13.9	13	9	0	15.8

Table II. Comparison Drop Test Data of the Three Test Packs

OC-ALC/DSPA's request included consecutive drop test data on the same face for the Lear pack and data for the TPO pack with the top and bottom cushions from the Lear pack. This data is listed in tables III and IV.

IMPACT SURFACE	PEAK ACCELERATION - Gs				DURATION msec
	X	Y	Z	R	
3 (bottom)	3	2	15	15.4	58
3 (bottom)	3	0	16	16.3	58
4 (back)	0	13	2	13.2	62
4 (back)	0	20	1	20.0	40
5 (l.side)	10	0	2	10.1	70
5 (l.side)	22	0	3	22.2	40

Table III. Consecutive Drop Test Data for Lear Pack

IMPACT SURFACE	PEAK ACCELERATION - Gs				DURATION msec
	X	Y	Z	R	
3 (bottom)	2	2	14	14.3	48
1 (top)	2	3	14	14.3	60
2 (front)	5	20	6	21.5	35
4 (back)	1	21	2	21.1	38
5 (l. side)	11	1	1	11.1	58
6 (r. side)	12	0	0	12.0	75
3 - 4 - 6 (corner)	12	12	13	21.4	25
3 - 4 (edge)	0	17	15	22.7	40
3 - 6 (edge)	12	0	10	15.6	50
4 - 6 (edge)	13	12	0	17.7	60

Table IV. Drop Test Data of TPO Pack with Lear Top and Bottom Cushions

Since the shock levels of the three test packs exceeded the 15 G fragility rating for this gyro, a new pack design was required. Design data, generated on AFPEA's computerized Package Cushion Design Program, resulted in a corner pad design which will protect the gyro during shipment.

To confirm the computer results, a prototype pack was fabricated and tested. The preliminary data revealed that the computer designed pack would provide adequate protection. The prototype pack is shown in figure 2.

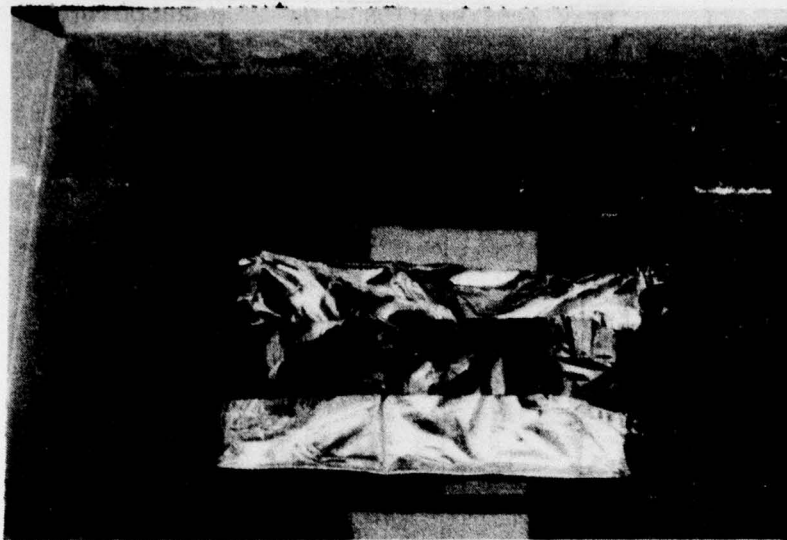


Figure 2. Prototype Corner Pad Test Pack

#### DISCUSSION

When OC-ALC/DSPA was informed of the improved performance that a corner pad design would provide, they incorporated the corner pad design with the XA5 Fast Pack as the inner container. This reduced the amount of cushioning material in the outer container and eliminated the need for the inner carton which included expensive polyethylene blocking inserts. The combination of the corner pad design with the XA5 Fast Pack reduced the maximum shock level to 14.8 Gs.

#### CONCLUSIONS

1. The Lear Siegler pack appeared to provide adequate protection when tested in accordance with standard drop test sequences. However, the soft polyurethane ether base foam will compress considerably and allow the item to slip within the cavity and become wedged in the corner. Because of this, the second of two consecutive drops on the same container face will generate shock levels which exceed the 15 G fragility value of the item.
2. The XA5 Fast Pack and the TPO pack will not provide adequate protection for the 7900D Gyro.
3. The combination corner pad design and the XA5 Fast Pack will provide the best protection at the lowest cost.

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