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AIR FORCE PACKAGING EVALUATION AGENCY WRIGHT-PATTERSON--ETC F/G 13/4
PERFORMANCE ANALYSIS OF REDESIGNED PACKAGING SYSTEM FOR THE C-5--ETC(U)
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PTPT-78-5

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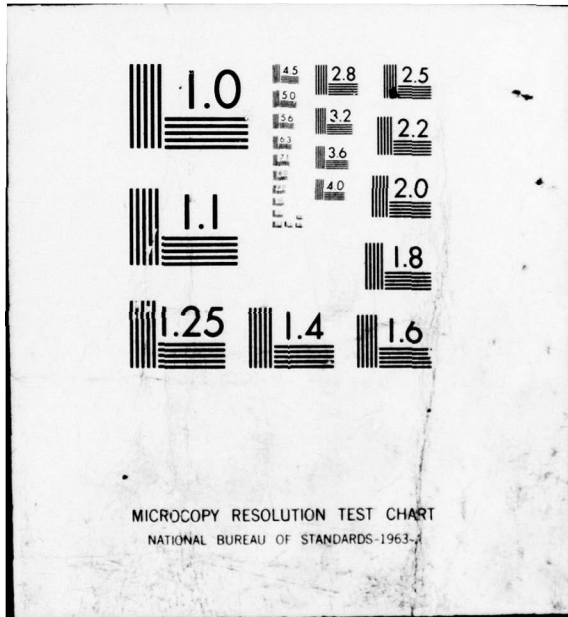
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6 PERFORMANCE ANALYSIS OF REDESIGNED PACKAGING
SYSTEM FOR THE C-5 INERTIAL MEASUREMENT UNIT.

HQ AFALD/PTP
AIR FORCE PACKAGING EVALUATION AGENCY
Wright-Patterson AFB OH 45433

11 February 1978

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ABSTRACT

In cooperation with the Aerospace Guidance and Metrology Center (AGMC), Newark AFS, Ohio, the Air Force Packaging Evaluation Agency (AFPEA), Wright-Patterson AFB, Ohio, designed, developed and tested a prototype reusable shipping container and cushion insert for the C-5 Inertial Measurement Unit (IMU). This program resulted in AGMC awarding a contract for fabrication of 60 of the new pack designs to replace the currently used wood container pack. As specified in the contract, the contractor provided AFPEA with a completed pack for verification testing prior to the fabrication and delivery of the 60 units.

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INTRODUCTION

The purpose of this evaluation was to prevent the possibility of an unsatisfactory packaging system from entering the Air Force inventory as a result of non-adherence to contractual specifications or misinterpretation of the specifications and drawings. A problem with this particular pack design occurred because the drawing was difficult to interpret and the test pack was not fabricated as specified. This resulted in the contractor using 90% more cushioning material than was required and would have prevented proper protection for the IMU. Tests could not be conducted on the cushion configuration as received from the contractor because the IMU shell could not be inserted into the cavity. However, refitting of the cushioning insert resulted in an acceptable pack for verification testing.

DESCRIPTION OF TEST PACK

Shipping Container: This container was vacuum formed from rigid (white) polyethylene and includes corrosion resistant hardware. It is a standard size reusable container manufactured by Thermodyne International Ltd. (part no. 102557, type ATA-300). The nominal dimensions are 28" x 25" x 28" (Figure 1).

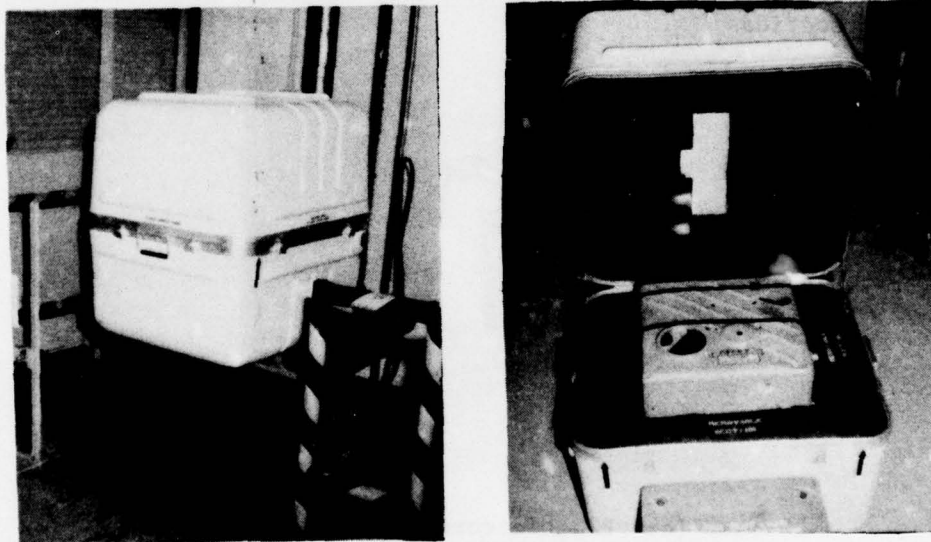
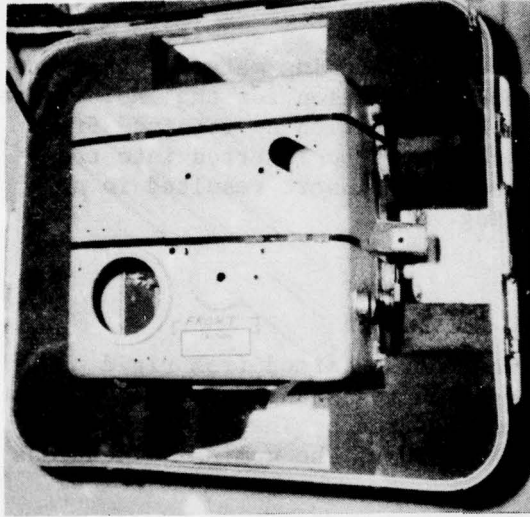
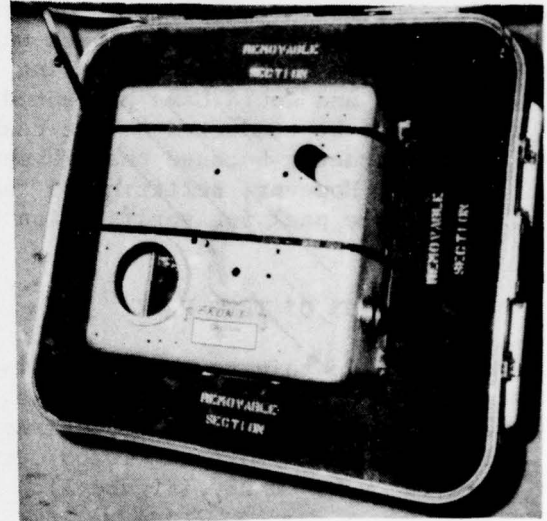


Figure 1. Test Pack

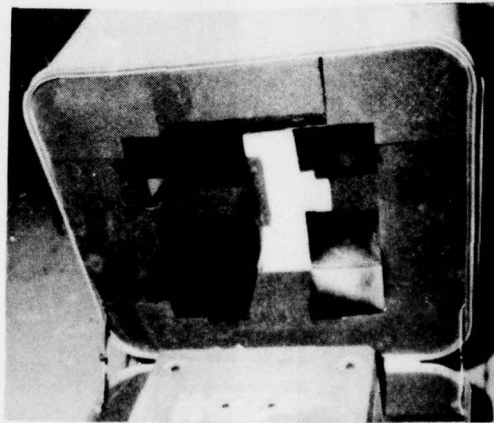
Cushion Insert: The cushioning material used is 4-pound polyurethane foam (ester base) bonded to the inner surfaces of the container with the exception of three removable cushion sections which allow for insertion of the IMU in the bottom cavity (Figures 2a and 2b). Plastic load distributors (corner plates) are bonded to the eight corner cushions to insure an equal weight distribution on the bearing surfaces and to prevent the IMU from tilting within the cavity walls (Figure 2c). The weight of the test pack is 51 pounds and the IMU is 85 pounds (gross weight 136 lbs).



(a) Without removable cushion sections



(b) With removable cushion sections



(c) Plastic corner plates

Figure 2.

TEST EQUIPMENT AND INSTRUMENTATION (Figure 3)

The following equipment and instrumentation was used to evaluate the test pack:

1. Gaynes Drop Tester
2. Oscilloscope, Tektronex 4 channel, Model 564B
3. Accelerometers, Tri-axial, Endevco Model 2233E
4. Power Supply, Endevco Model 2622C
5. Amplifier, Endevco Model 2614C

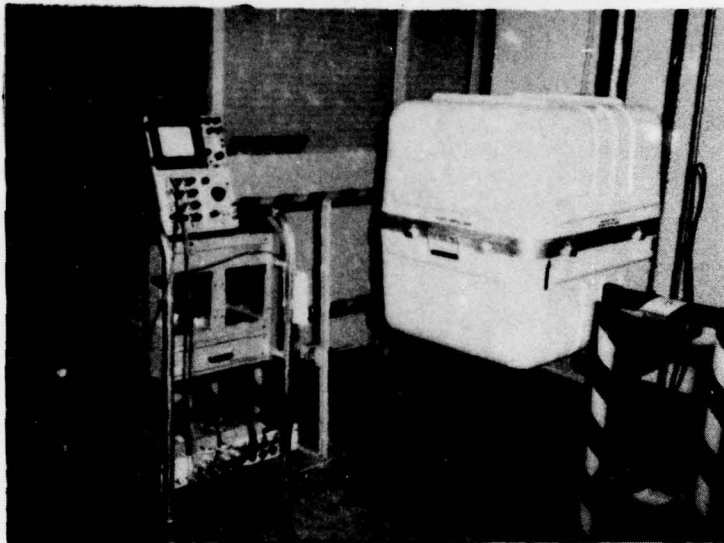


Figure 3. Test Apparatus

TEST PROCEDURE

Prior to conducting the drop tests on the pack provided by the contractor, the cushion insert was removed from the top and bottom sections of the container, the bonded joints were separated and the insert cut to the dimensions prescribed in the contract drawing. The modified sections were then re-bonded to the container walls. The scrap material resulting from this operation is shown in Figure 4.

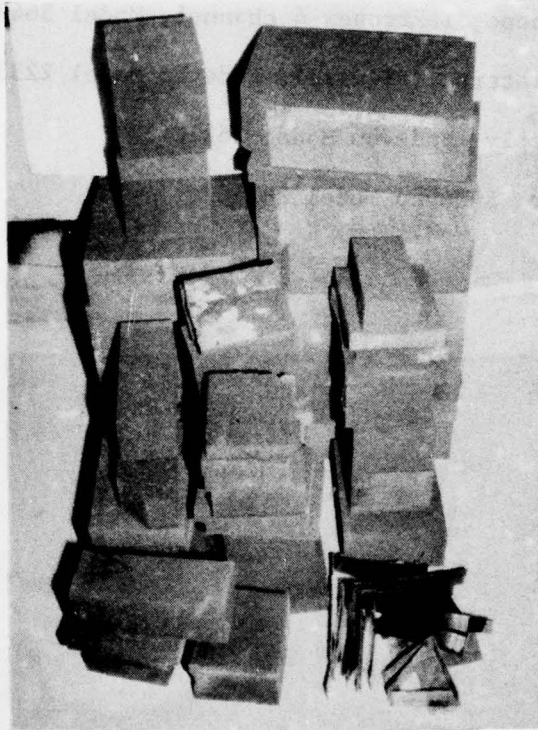


Figure 4. Scrap Material

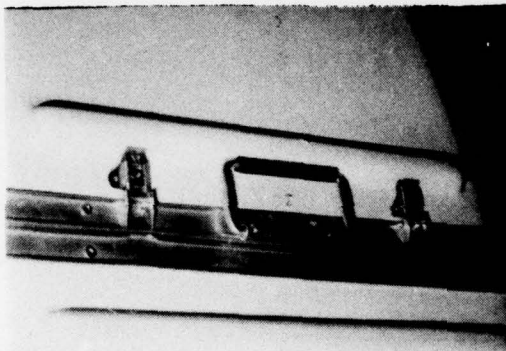
The free fall drop testing was conducted in accordance with Method 5007 of the Federal Test Method Standard 101B. The container was instrumented with a simulated 85 pound IMU and subjected to 6 flat face, 3 edge and 1 corner drops from a height of 21 inches. A tri-axial

accelerometer was located at the center of gravity of the test load. The results were displayed on the oscilloscope screen.

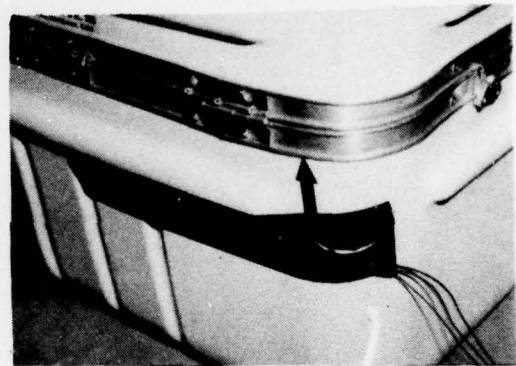
RESULTS

The average resultant force of the 10 drops produced a shock level of 15.0 Gs. The bottom face received a resultant force of 14.1 Gs. Since the item fragility is 15 Gs, this container should protect the IMU from a drop height up to 21 inches.

Minor damage occurred during these rough handling tests. The corner drop caused a slight indentation of the polyethylene container and the 4-6 (faces 4 & 6) edge drop caused damage to the right front and right side fasteners, allowing the container to be partially open (Figure 5a). During this series of drops, the container hinge was bent as shown in Figure 5b.



(a) Damaged Fastener



(b) Damaged Hinge

Figure 5.

This damage was considered to be minor because the parts could be straightened with standard hand tools.

DISCUSSION

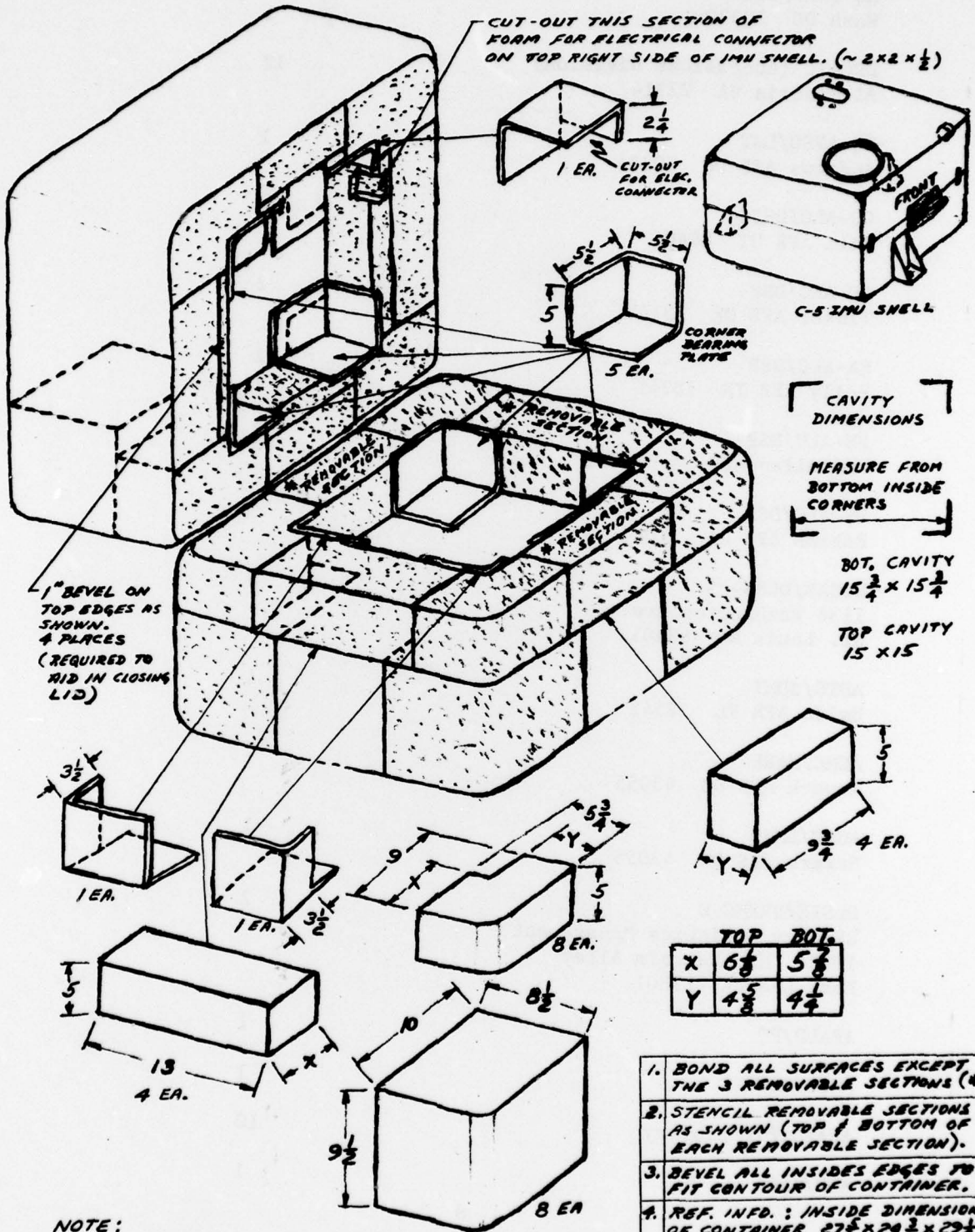
In addition to the drop tests, the cushioning material characteristics were evaluated and found to be acceptable as per MIL-26514D. The polyurethane was analyzed and verified by the Air Force Material Laboratory (AFML) to be an ester base as required in the contract.

After the completion of the tests, the modified pack was returned to the contractor to be used for reference during the fabrication of the 60 required units.

IMPLEMENTING ACTIONS

After the completion of this evaluation, the AGMC procurement office at Newark AFS was notified of the test results and copies of the revised drawing (Attachment 1) were provided for distribution to the contractor.

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NOTE:
THIS DRAWING SUPERSEDES ORIGINAL DRAWING
ATCH. 1 OF CONTRACT IFB F33659-77 80018

1. BOND ALL SURFACES EXCEPT THE 3 REMOVABLE SECTIONS (4).
2. STENCIL REMOVABLE SECTIONS AS SHOWN (TOP & BOTTOM OF EACH REMOVABLE SECTION).
3. BEVEL ALL INSIDE EDGES TO FIT CONTOUR OF CONTAINER.
4. REF. INF. 2: INSIDE DIMENSIONS OF CONTAINER 27 1/2 x 29 3/4 x 29 1/4

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Atch 1

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) In cooperation with the Aerospace Guidance and Metrology Center (AGMC), Newark AFS, Ohio, the Air Force Packaging Evaluation Agency (AFPEA), Wright-Patterson AFB OH, designed, developed and tested a prototype reusable shipping container and cushion insert for the C-5 Inertial Measurement Unit (IMU). This program resulted in AGMC awarding a contract for fabrication of 60 of the new pack designs to replace the currently used wood container pack. As specified in the contract, the contractor provided AFPEA with a completed pack for verification testing prior to the fabrication and delivery of the 60 units.		

