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January 8, 1982

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Attention: Mr. Joe E. White, E-14

Subject: NAS8-34127 Final Report

Dear Mr. White:

A copy of the final report for work performed under contract NAS8-34127 is attached. This report describes SL-2 mockup hardware developed for cable routing purposes.

We appreciate the opportunity to work with you and your staff and look forward to the opportunity to support your organization on future projects.

Sincerely,

Charles N. VanValkenburgh

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(NASA-CR-161975) THE DESIGN, FABRICATION AND INSTALLATION OF CABLE ROUTING MOCKUPS IN SUPPORT OF SPACELAB 2 Final Report (Essex Corp.) 6 p HC A02/MF A01 CSCL 22B

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FINAL REPORT

THE DESIGN, FABRICATION AND INSTALLATION OF CABLE ROUTING MOCKUPS IN SUPPORT OF SPACELAB 2

Contract NAS8-34127

Prepared For:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
George C. Marshall Space Flight Center
Marshall Space Flight Center, Alabama 35812

Prepared By:

ESSEX CORPORATION
3322 South Memorial Parkway
Huntsville, Alabama 35801

23 December 1981
H-81-06

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1.0 INTRODUCTION

This final report describes the fulfillment of requirements of NASA contract NAS8-34127 by the Essex Corporation. The contract involved the design, fabrication and installation of Spacelab 2 (SL-2) experiment and hardware mockups. The mockups were to be located on the three SL-2 pallets to comprise a SL-2 wiring mockup. Included in the mockup package were floor panels (72), cold plates (14) and orthogrids, as well as experiment mockups, power distributor mockups and cable routing brackets. Electrical connector mockups were to be fabricated and located where necessary to accurately support cable and wiring tasks. In order to reduce costs, larger experiments such as the Instrument Pointing System, Experiment 7 telescope and Experiment 5 telescope were to be represented only in the form of a footprint.

When the original contract, which was awarded August 26, 1980, was initiated the scope of the work was not fully known by either the contractor or the contracting officer's representative (COR). For this reason, the contract was modified May 20, 1981 to account for Exhibit "B", the production of approximately 80 cable routing brackets.

2.0 TASK DESCRIPTION

During the contract, Essex received flight and mockup drawings of SL-2 experiments and hardware from the COR. From these drawings Essex produced shop-ready mockup drawings. In some cases, it was only necessary to redline a flight drawing or produce a dimensioned sketch. As mockup drawings were compiled, they were delivered to the COR for approval; then they were released to local shops for fabrication and painting. As completed mockups were delivered, they were inspected and approved by both Essex and the COR. Then installation drawings were supplied to Essex, and the mockups were installed to the satisfaction of the COR.

Since floor panels are the foundation of any pallet-mounted mission, they were the first items considered for fabrication on this SL-2 mockup. With a total of 72 floor panels in only 8 different configurations, Essex deemed it necessary to reduce fabrication costs by producing them using mass productive means. Using the Spacelab Payload Accommodations Handbook (SPAH), Essex prepared drawings which were used to produce wooden vacuum-form panel molds. The panels were then vacuum-formed and installed on the three pallets with particle board backing.

Cold plate and orthogrid mockups were designed from NASA-supplied drawings and fabricated with wooden tables and aluminum supports. Wooden orthogrid tables were covered with black formica and striped with white adhesive tape which represented the typical orthogrid structure. Painting was done both in-house at Essex and at a local paint shop. Again, delivery and installation were to the satisfaction of the COR.

Experiment and other hardware mockups were fabricated of aluminum or plywood, depending on size and configuration. After fabrication, aluminum mockups were painted white. Some wood mockups were painted, but it was found that a great deal of finishing time could be eliminated by covering larger wooden mockups with white formica. After all the aforementioned hardware was installed, the COR gave final approval, and Exhibit "A" was completed.

Eighty-three cable routing bracket mockups were fabricated in fulfillment of the requirements of Exhibit "B". They were fabricated of aluminum and delivered to NASA for painting. The painted mockups were installed by Essex on the SL-2 mockup to the satisfaction of the COR.

3.0 SUMMARY

The Essex-prepared SL-2 cable and routing mockup is shown in Figure 1. A few of the major components are labeled. Please note that the photo was taken before installation of any cable-routing brackets. In fulfillment of this contract, Essex has produced and installed:

Floor panels (72 total)
Cold plates (14 total)
Orthogrid and support struts
Mini-shelf and support struts
Experiment 5 base
Experiment 7 base
Instrument Pointing System (IPS) base
IPS payload clamp assembly
IPS-PEU
HDRR electrical box
HDRR recorder
Experiment 8 electrical box
IPS accelerometer
Experiment 7 electrical box
EPBD
Experiment 5 electrical box
Experiment 3 electrical box and antenna
Experiment 13 electrical box
Interface of Experiment 6
REM and control box
Experiment 12 low-G accelerometer
Vacuum pump support

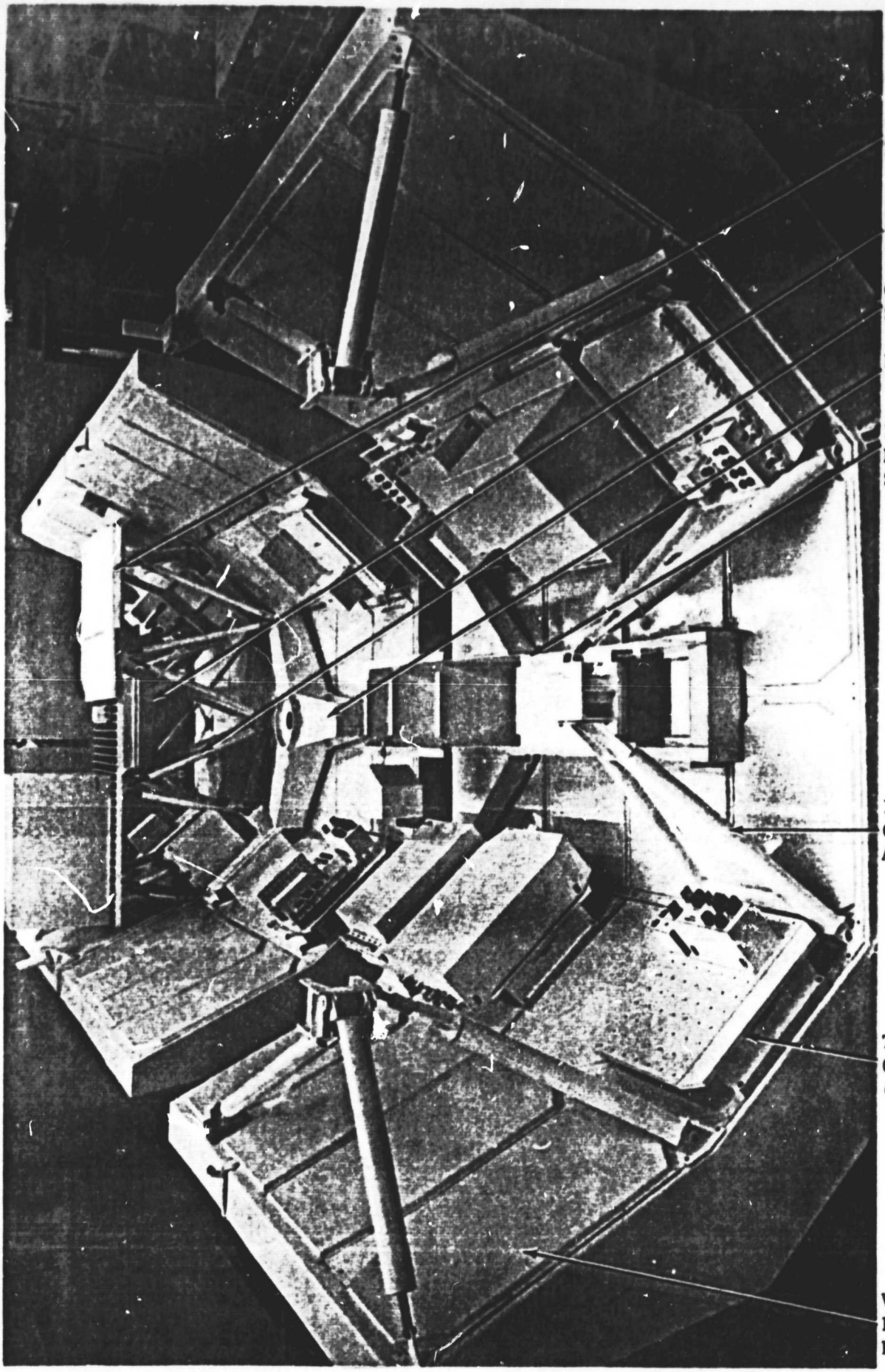

Figure 1 - SL-2 Cable Routing Mockup
(View Looking Aft)

Branching units 25 and 26
VFI mockups (approximately 183)
Multilayer insulation (MLI) frame
Cable routing brackets (82 total)
Other miscellaneous items not previously mentioned.

All mockups were securely fastened to pallets and other hardware with self tapping screws or 1/4 in. bolts and nuts as required. Upon completion of installation, mockups were cleaned of smudges, and white touch-up paint was applied where needed.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The fabrication of the SL-2 mockups provided Essex the opportunity to utilize low cost fabrication techniques not normally associated with mockups found at MSFC. The mockups utilize aluminum, wood and plastic where properties of the three materials were most appropriate. Time and cost savings were realized in several areas enabling Essex to produce a low cost mockup with high fidelity where needed.

A great deal of time and costs were saved and a higher level of fidelity was achieved in the vacuum-forming process that produced the floor panels. Since only 8 molds had to be finished to produce 72 smooth floor panels, there was a difference of 64 panels which did not have to be finished. And since the plastic sheets were white, there was no painting required on any of the panels. In producing the molds, a flight-type beveled edge was incorporated which is not generally present on mockups of this type.

In the case of cold plates and orthogrids, the use of plywood proved beneficial in producing well finished, structurally sound parts. In most cases, however, the use of the less expensive plywood proved more costly than the more expensive aluminum because of increased finishing time. An aluminum part is smooth and almost ready for paint as soon as it is formed, but wood requires effort to remove grain and to fill nail or screw holes and corners. When wood is used as a mockup material, it is worthwhile considering formica to add the finish color as opposed to paint. In most cases, however, aluminum is a superior mockup material.

As a fastening device, self-tapping wood screws were primarily used. These fasteners are highly recommended. They can be driven with an electric or pneumatic drill into wood, particle board, formica and aluminum. They require no pre-drilling; one simply holds a part in place and "drills" a screw to fasten it.

Knowledge and experience gained from this contract should benefit both NASA and Essex in carrying out future contracts where low cost envelope mockups are required. Knowledge of the design and fabrication solutions developed for this project will allow more accurate bidding and a higher fidelity-to-cost ratio in future contracts.