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**The Long Duration Exposure Facility (LDEF)
Photographic Survey Special Publication**

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During the construction, integration, launch, retrieval and deintegration of the Long Duration Exposure Facility (LDEF), photographic surveys were made. Approximately 10,000 photographs were taken during the various phases of the LDEF project. These surveys are of technical and scientific importance because they revealed the pre and post flight conditions of the experiment trays as well as the spacecraft. Visual inspection of the photographs reveal valuable data such as space environment's effects and the earth atmosphere's effects post-retrieval. Careful files and records have been kept of these photographs. Each photograph has a Kennedy Space Center photo number or a Johnson Spaceflight Center photo number as well as a Langley Research Center photo number. The tray number, row number, and experiment number are also noted.

Out of the 10,000 photographs taken, approximately 700 selected photographs were chosen for publication in a NASA Special Publication (SP) because they reveal the effects of space exposure to the viewer. These photographs will give researchers and spacecraft designers visual images of the effects of the space environment on specific materials, systems and spacecraft in general. One can visually see the degradation of thermal blankets, meteoroid craters, outgassing discoloration, atomic oxygen erosion, etc.

The photographs published in this NASA Special Publication (NASA SP) will appear in black and white on the printed page and in high-resolution color images on a CD-ROM. An index to all (approximately 10,000) photographs will be published as a separate appendix. In addition to the photographs, the photo numbers, location, experiment number and title, the authors will prepare a materials list for each experiment tray as well as a brief discussion of the experiment. Scanning these photographs began during the summer of 1994, and the CD-ROM and SP should be available in 1995. The following text and photographs are an example of the entries in this NASA SP.

Heavy Ions In Space (M-0001)

Naval Research Laboratory

The objective of this experiment is to provide a deep survey of intensely ionizing particles in low earth orbit. The experiment used eight thick stacks of plastic track detectors mounted in two trays on the space facing end of LDEF. Plastic track detectors record charged particles by the trails of radiation damage they leave as they pass through the detector sheets. These tracks are revealed by chemical etching the detectors in the laboratory after flight. The stacks were made up of a unique arrangement of CR-39 and Lexan sheets. Seven of the eight modules were identical and used a honeycomb lid pressure cover. In the eighth module the fiberglass lid was replaced with four thin Kapton window pressure covers to provide a lower energy threshold to ion penetration.

Preflight (Figure 1)

The four modules including the one subdivided into quadrants are shown mounted in a 4-inch deep space facing end tray. The exposed surface of each detector is Chemglaze II A-276 white paint on the aluminized Kapton top layer of a multilayer thermal blanket. The frame around each of the four modules is a "Z" shaped aluminum structure covered with a silvered teflon film secured with 3M-Y966 acrylic tape. The 3M-Y966 tape on a silvered teflon film is also used to attach the multilayer thermal blankets to the module frames.

In Orbit (Figure 2)

This photo shows extensive damage to the thermal cover of each module. It appears the tape used to attach the thermal blankets to the structure failed in tension. When the bond joint released along two sides the tension was relieved and the remaining tape continued to hold the blanket. The outside painted surfaces that were white are now discolored and are a somewhat glossy brown. The gold colored material underneath the failed covers in the three full modules are the top sheets of lexan detector stacks held in place by the aluminum "Z" shaped struc-

ture. The dark brown discolored sections visible underneath the failed cover of the fourth module is also the top layer of detector sheets underneath support straps. A light discoloration is visible on the tray flange near the American flag.

Postflight (Figure 3)

This photo was taken prior to the experiment tray being removed from LDEF. The damaged thermal blankets were removed so the experiment tray protective cover could be installed prior to tray removal. The photo shows the thermal covers on all modules to be severely damaged. The paint on the top layer that was white prior to flight is now discolored and brown in color. The thermal blankets shrunk in flight due to thermal cycling causing the taped attachment to the structure to fail along two sides. The tape used to attach the blanket apparently failed in tension leaving portions of the tape on both the frame and the top layer of the blanket.

The thermal blankets on the three large modules have curled to expose the top Lexan layer of the detector stack beneath. The curled blankets that protected the four smaller modules now expose the 5-mil thick aluminized kapton pressure covers beneath.

The damaged thermal covers shown in the two tray quadrants on the right side of the photo reveal representative cross sections of the multilayer thermal blankets. The thermal blankets top layer is a 5-mil thick aluminized Kapton film painted with Chemglaze II A-276 white paint. The blanket core is constructed of approximately twenty two (22) layers of 1/4-mil thick perforated mylar film with aluminum vapor deposited on each side. A dacron mesh separator seen in the lower right quadrant is placed between each aluminized mylar layer of core material and also between the core material and the aluminized Kapton film used for the blanket top and bottom covers.

Heavy Ions In Space (M-0001)



Figure 1

Photo No.: KSC-384C-331/6
Photo credit: KSC 1/24/84
Digitized from dup. neg. L84-7187
Location: KSC SAEF II
Subject: Tray H12
Experiment: M-0001; Heavy Ions In Space



Figure 2

Photo No.: S32-75-067
Photo credit: JSC 1/12/90
Digitized from dup. neg. L90-10,373
Location: In Orbit
Subject: Tray H12
Experiment: M-0001; Heavy Ions In Space



Figure 3

Photo No.: L90-1796
Photo credit: LaRC 2/6/90
Digitized from dup. neg. L90-1796
Location: KSC SAEF II
Subject: Tray H12
Experiment: M-0001



SPACE STATION

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