

MICROORGANISMS AND BIOMOLECULES IN  
SPACE HARD ENVIRONMENT  
(1ES029)

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Exposure to space hard environment may influence living matter at the cellular level (inactivation, mutation induction, growth disturbances), at the subcellular level (membrane damage, genome alteration, enzymatic disorganization), and at the molecular level (conformation alteration of macromolecules, radiation products in DNA and protein).

In this experiment, microorganisms and biomolecules will be exposed to space vacuum and to different intensities of selected wavelengths of solar ultraviolet radiation. The objective is to measure quantitatively the influence of these factors, applied singly or simultaneously, on the integrity of microbial systems and biomolecules. Specifically, this experiment will be used to study in *Bacillus subtilis* spores (1) disturbances in subsequent germination, outgrowth, and colony formation; (2) photochemical reactions of the DNA and protein in vivo and in vitro and their role in biological injury; and (3) the efficiency of repair processes in these events. For that purpose, about 350 dry samples of the different test systems, which are accommodated in four square-shaped, quartz-covered containers will be exposed to selected combinations of space vacuum and of solar irradiation of different wavelengths and intensities (Fig. V-14). The wavelengths will be selected by a filter system, while a shutter will be used to determine the total exposure time.

The data from postflight evaluation of the biological flight and the ground control samples will be compared with the findings of simulation experiments on the ground (Table V-1). Precise information on the effects of space factors on living matter is expected which may contribute to the solution of several problems of space biology (e.g., the contamination problem, hazards to man by microbial mutants, and the interplanetary transfer of biological matter). Contributions to problems in basic research (e.g., the role of water in biological systems, primary processes of radiation, and the function of the ceil envelope) are also expected.

TABLE V-1. VACUUM EFFECTS ON BACTERIA

Effects Observed in Colony Formers

- Prolonged lag-phase of subsequent growth
- Repair of cell membrane damage during lag-phase
- Increased sensitivity to X-rays
- Increased sensitivity to UV radiation
  - No photoenzymatic repair
  - Little or no excision repair
  - DNA -protein cross-links
  - Spore type photoproduct
  - Trans-synthymine dimer
- Decreased sensitivity to heat

Effects Observed in Noncolony Formers

- No cellular elongation
- No phage production
- No respiration
- Damage to the cell envelope

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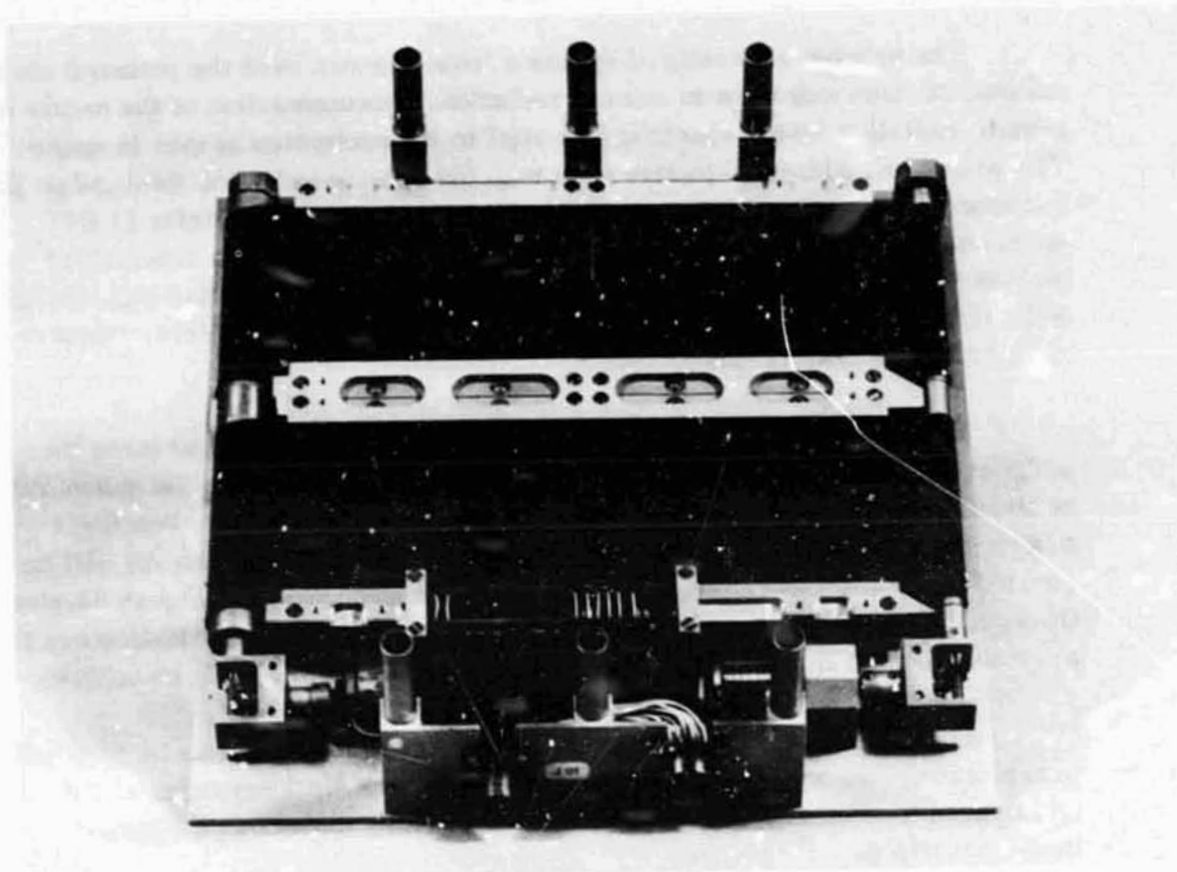


Figure V-14. Hardware of the exposure box assembly without cover.