

moose

MANNED ORBITAL OPERATIONS SAFETY EQUIPMENT



GENERAL ELECTRIC COMPANY • MISSILE AND SPACE DIVISION • RE-ENTRY SYSTEMS DEPARTMENT

RESCUE SYSTEM NEEDED

Of all the challenges confronting man in his quest for mastery of space, one of the most elementary remains unsolved in practice. How can astronauts save themselves or be rescued in a space emergency?

To date, American astronauts have benefited from the highest possible standards of mission planning, equipment design and manufacturing precision. They have been superbly qualified and thoroughly trained for their missions. Fortunately, elaborate emergency backup systems and procedures have been able to cope successfully with the few limited emergencies that have arisen thus far.

But as missions become longer and more complex, as bigger and more sophisticated spacecraft carrying larger crews are launched into space with increasing frequency, sooner or later, something serious may go wrong that will require evacuation of the spacecraft. It is for just such an emergency that an effective space rescue system is urgently needed.

Such a rescue system must not only protect survivors from the space environment but must also provide controlled de-orbit and re-entry capabilities. MOOSE (Manned Orbital Operations Safety Equipment), a space rescue system conceived at the General Electric Re-entry Systems Department, answers these requirements.

WHAT IS MOOSE?

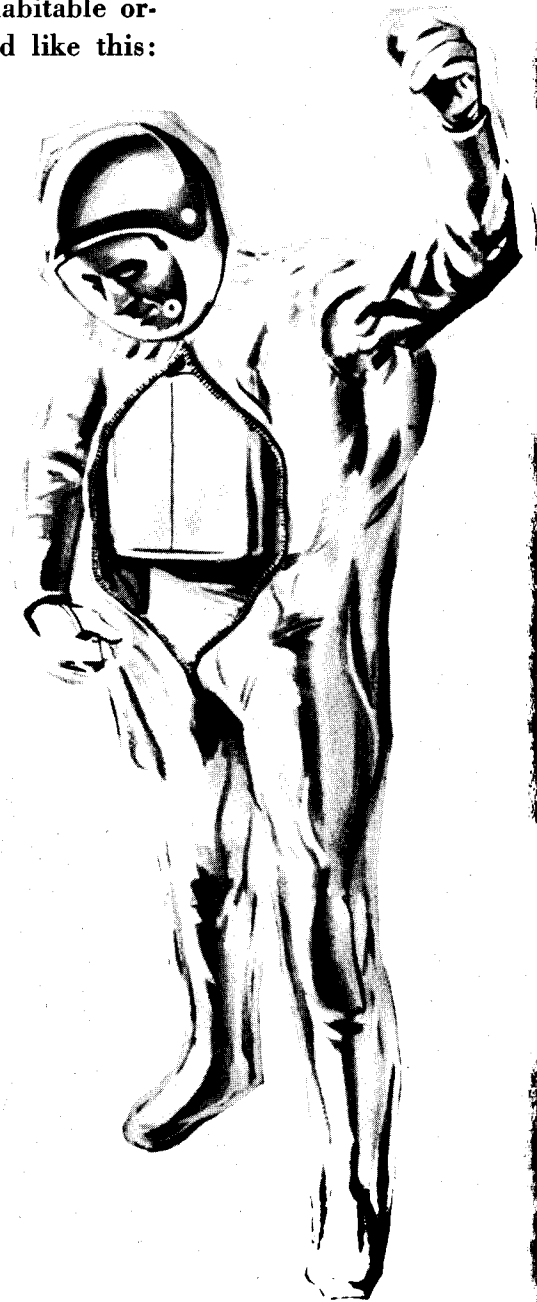
Simply described, MOOSE is a lightweight, erectable, one-man re-entry vehicle for emergency return to earth. Each MOOSE unit provides one astronaut with the capability for leaving the vicinity of his damaged or malfunctioning spacecraft, orienting himself for de-orbit, accurately de-orbiting himself, re-entering the atmosphere safely, achieving a soft landing on land or water, signaling his location, and surviving until a rescue team reaches him.

A step-by-step operational sequence for a MOOSE escape from an uninhabitable orbiting spacecraft would proceed like this:

1

The astronaut dons a maximum protection space suit similar to that used on "space walks". The MOOSE unit is attached to the back of the suit, to which are also attached oxygen tanks and a chest-type parachute.

First, the astronaut removes the packaged MOOSE from its container, which is about the size of a two-suiter suitcase. He then unfolds a 6-foot Mylar plastic bag (fabricated to assume the correct re-entry configuration when filled with foam) to which the quarter-inch heat shield is bonded. The unfolded heat shield is in the shape of a shallow cone, and is made of General Electric Elastomeric Shield Material (ESM). After stepping into the Mylar bag and slipping into a harness, the astronaut zips the bag closed. At this point his body occupies a kind of pocket built into the front side of the bag.





2

As he pushes himself away from his disabled spacecraft, the astronaut initiates the foaming process using foam contained in two cylinders hung from the Mylar bag. By activating the foam canisters, the astronaut squirts the expanding plastic foam into the plastic bag so that it forms a solid wall, contoured to his back and sides, separating his body from the heat shield. The foaming process takes only a few minutes, and, when completed, causes the Mylar bag to assume its correct re-entry shape.

At this point the astronaut is comfortably encapsulated with foam at his back and sides, the front of his body protected only by the aluminized plastic sheet.

3





4

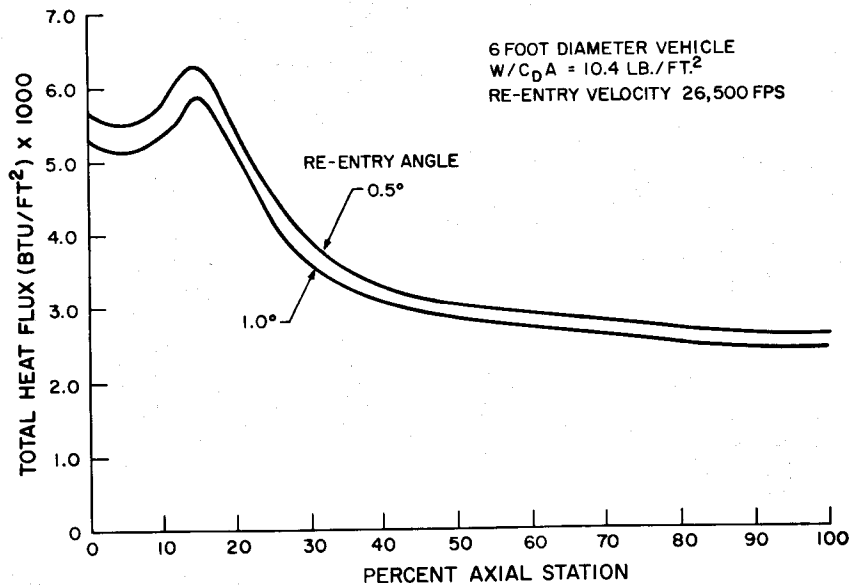
Next, he uses his attitude/de-orbit package to orient the MOOSE to the correct de-orbit attitude. This package contains, among other things, a portable rocket motor. The twin jet exhausts of the motor protrude through the plastic cover in front of the astronaut and fire in the backward direction. The astronaut fires the rocket motor in bursts to achieve the correct de-orbit trajectory and attitude, getting his bearings by sighting on the earth's horizon. After the correct de-orbit velocity has been attained the astronaut orients the MOOSE to the proper re-entry attitude. Shortly before re-entry he releases the entire attitude/de-orbit package.

5

The re-entry sequence requires no further effort by the astronaut, who sees himself surrounded by a ball of fire as the friction of the earth's atmosphere boils away the outer layers of his ablative heat shield. Although engulfed by flame, no heat reaches the astronaut's body—protected by the insulating plastic foam and his space suit. Since the astronaut faces away from his re-entry path, the reflective plastic sheet provides ample shielding across the front of his body.



MOOSE RE-ENTRY TOTAL HEATING



MANNED ORBITAL OPERATIONS SAFETY EQUIPMENT (MOOSE) WEIGHT STATEMENT

COMPONENT	WEIGHT (Pounds)
RE-ENTRY VEHICLE	
ENVIRONMENTAL & ATMOSPHERIC CONTROL	11
SURVIVAL KIT	12
BEACON, ANTENNA, BATTERY	8
RECOVERY AIDS, PROGRAMMER, SWITCHES	15
PARACHUTE	13
FOAMED STRUCTURE	130
VEHICLE AT RE-ENTRY	189
PAYLOAD	
ASTRONAUT	180
SPACE SUIT	25
RECOVERED PAYLOAD	205
TOTAL WEIGHT AT RE-ENTRY	394
EQUIPMENT JETTISONED PRIOR TO RE-ENTRY	
FOAM COMPONENT, TANK & MIXER	10
ATTITUDE/DE-ORBIT PACKAGE	50
MOOSE CONTAINER	5
	65
TOTAL SYSTEM WEIGHT	459

The MOOSE vehicle weighs just over 200 pounds at re-entry; carrying a 180 pound astronaut, it experiences only about one-tenth of the heat that chars the much heavier Mercury and Gemini vehicles upon re-entry from orbital flight. Further, the Gemini capsule takes about one-third of the distance around the earth to descend from orbit, whereas the much lighter MOOSE vehicle would make a more gradual descent, moving half-way around the world in its penetration of the atmosphere.

The General Electric Company's Re-entry Systems Department has developed and tested much of the MOOSE system. The foldable heat shield has been fabricated to full scale. The shield material itself has undergone exhaustive testing, with samples having been flown successfully on a Mercury spacecraft and several ballistic re-entry vehicles. Polyurethane plastic foam has been employed in full scale tests of foaming the MOOSE shape and foaming-in a man. The attitude/de-orbit package and other associated equipment are well within existing technology capabilities.

Almost eight years of study and development within General Electric have been devoted to proving the feasibility of the MOOSE system.

MOOSE represents a unique design concept for emergency vehicle return of a man from orbit. While admittedly a last resort — and certainly no substitute for design excellence, manufacturing precision, thorough testing, maintenance and training, in other words, long term reliability — a workable space rescue system is insurance against a disaster.

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