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# GET AWAY SPECIAL

# (GAS)

# EDUCATIONAL APPLICATIONS OF SPACE FLIGHT

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**ABSTRACT** - The National Aeronautics and Space Administration (NASA) has established the Small Self-Contained Payloads (SSCP) program, commonly known as the Get Away Special (GAS) program, as a means for providing anyone who wishes the opportunity to place a small self-contained experimental payload on the Space Shuttle at a very low cost. These payloads must be of peaceful intent and be an engineering and/or a science endeavor. The GAS program is well established and to date has flown 53 payloads. The GAS community consists of experimenters from all walks of life and from many nations throughout the world.

One of the prime objectives of the GAS program is to foster enthusiasm in the younger generation in the use of space. This paper looks at the history of the program from its initiation through the development phase, its interaction with the educational community, the educational/industry

relationship, some educational objectives, addressing the programmatic and technical relationships that are established with NASA and the GAS customer, and a brief look into the future.

## I. INTRODUCTION

NASA began in the mid-1970's, while production of the first flight Orbiter was nearing completion, to perform manifesting exercises. As experience was gained manifesting various combinations of major payloads, it became obvious that there would often be small amounts of volume and weight capability remaining following installation of the prime payloads. Discussions of various alternatives of how to make effective use of that "leftover" capability led to the creation of the GAS program.

NASA announced the GAS program to the aerospace community during a meeting of the American Institute of Aeronautics and Astronautics in December 1976. Before the conference had ended, Mr. R. Gilbert Moore, an executive of the Thiokol Corporation, committed his personal resources to purchase the first GAS payload reservation. Mr. Moore later donated his payload reservation to the Utah State University in Logan, Utah. Thus started the close relationship with the educational community.

## II. BACKGROUND

After announcement of the program, the Sounding Rocket Division at the Goddard Space Flight Center (GSFC) in Greenbelt, Maryland, was given the task of designing and developing the hardware systems to support and execute the GAS program. The Sounding Rocket Division by that time had managed the sounding rocket program for about 20 years. During that time the Division accumulated a great deal of experience in working on varied projects of short duration with limited resources using a very "hands on" approach to accomplishing their mission. This experience has proved to be of great value in designing and operating the GAS program, considering that some of the GAS customers begin their projects with very little knowledge of how to organize or manage a science oriented project. The Sounding Rocket Division, now known as the Special Payloads Division, at GSFC, continues in the Space Shuttle era to execute the GAS program in the same straightforward manner.

The GAS carrier system, from the beginning was intended to provide an envelope which would safely isolate the payload for the Orbiter, and the concept of the GAS canister as a pressure vessel was well established before the actual design work began. This concept was the basis for choosing the form of a relative thin walled cylinder with thicker plates on either end (see figure 1). It was also agreed from the start to offer three sizes of payload weight and volume for the experimenter to choose from, and to charge for the payloads in a manner similar to major payloads, based on weight and volume. The prices charged for GAS payloads remain the same as originally announced.

## GET AWAY SPECIAL PRICES

| Canister Volume | | Experiment Weight | | Price in |
|---|---|---|---|---|
| Cubic Meters | Cubic Feet | Kilograms | Pounds | U.S. Dollars |
| .07 | 2 1/2 | 27.2 | 60 | $3,000 |
| .07 | 2 1/2 | 45.4 | 100 | 5,000 |
| .14 | 5 | 90.7 | 200 | 10,000 |

The canisters referred to above are the NASA standard canisters for the Get Away Special payloads. The canisters are cylindrical and are 49.6 centimeters (19.75 inches) in diameter. The .07-cubic-meter canisters are 35.89 centimeters (14.13. inches) long. The 14-cubic-meter canisters are 71.6 centimeters (28.25 inches) long. Canister bottoms and sides are insulated. A selection of canister tops (mounting plates) is optional. Some, like the one that is openable or the one that is optically transparent, are optional at extra cost. The canister may be sealed or, if space vacuum is needed, vented.

Personnel at NASA Headquarters began to define the policy which would become the rule for operating the program. At the same time design work was getting under way at Goddard. NASA Headquarters and the GSFC began their respective tasks while more and more prospective customers began to purchase payload reservations. By the time the proposed policy was published, earnest money payments had been received for more than 320 payloads.

Upon completion of the proposed policy, a copy was mailed to each customer who had purchased a GAS payload reservation to date along with an invitation to attend one of the two briefings on the policy. The briefings were held at the GSFC in Greenbelt, Maryland and at the Jet Propulsion Laboratory in Pasadena, California. The 90 day comment period which followed the publication and briefings of the proposed policy resulted in many comments. The first two comments heard most often was the concern with tying the prices to the inflation rate, which by this time would have almost doubled the prices originally proposed. The second concern was with the restriction on performing experiments only in closed canisters which was the original intent of the program. After reviewing the comments, NASA agreed to freeze the prices for at least the first three operational years, and committed to providing a Motorized Door Assembly (MDA) for an optional fee, which would allow GAS payloads to be exposed to space during flight. Making a GAS payload reservation continued to be a simple process. Upon receipt of a non-refundable earnest money payment of $500 for each GAS payload reservation desired, NASA will issue a payload reservation number and begin negotiations with the new customer.

The design and construction of the NASA Flight Verification Payload (FVP) began while development and testing of the standard GAS flight systems continued at GSFC. The intent of the FVP was designed to measure the environment within a GAS canister during an actual mission. The FVP was designed to measure accelerations and pressure changes inside and outside the canister as a means of determining the effectiveness of the passive insulating system. The FVP was flown on STS-3, launched on March 22, 1982. The primary mission of STS-3 was to stress the Orbiter thermally which gave the FVP the opportunity to measure extreme temperature differentials. During STS-3, the cargo bay was oriented towards both deep space and the Sun for longer periods than those normally occur during operational Shuttle missions.

The FVP gathered a great deal of data which was subsequently published and shared with the GAS experimenters. The data was also incorporated into later revisions of the GAS Experimenters Handbook, and into a thermal design summary published at GSFC. Perhaps equally as important as the data gathered were the lessons learned by taking an actual payload through the review process, transporting it to the

Kennedy Space Center (KSC), and working it through the integration process and all of the steps that led up to the installation in the Orbiter. The experience gave the GAS team the opportunity to deal with the actual working conditions that would soon be shared by the experimenters. Initial working contacts were made with personnel at the Johnson Space Center (JSC) and the KSC during the development and integration of the FVP that remain valuable to the GAS program to this day.

The first GAS payload was put into orbit just over three months after the FVP on June 27, 1982. G-001 was the payload which was purchased by Mr. R. Gilbert Moore when the GAS program was announced in December 1976. Mr. Moore's payload was designed, fabricated, integrated and tested by students at the Utah State University in Logan, Utah. Under the supervision of Dr. Rex Megill, other faculty members, and several interested personnel of the Thiokol Corporation in Wasatch, Utah, a very ambitious payload was conceived and executed. The payload contained 10 experiments, each contributed by an individual student. The large number of experiments complicated the integration process considerably, and the payload may have been as much of a challenge to NASA as it was to Dr. Megill and his students. Looking back, it was an excellent subject for NASA for the first payload to be reviewed, certified, and flown. Lessons learned by NASA during the review and safety certification of G-001 have benefited every GAS payload that has followed in its footsteps. It was felt that the engineering experience that was obtained by the students was second to none and that the results of the experience would be of a lasting nature to each and every student that participated in the design and development of the experiments, and the final integration and flight of the payload.

The FVP and G-001 were integrated in Hanger "S" located in the industrial area on the Canaveral Air Force Station. By this time, the Shuttle program was expanding and the space for integration payloads began to be more and more difficult to find. A search for a facility dedicated to the integration and support of GAS payloads resulted in the assignment of a building, which was originally built for preparation of Delta rocket third stage motors, to the GAS program. That existing building was enhanced by the addition of office space in the form of a mobile home. The GAS Preparation Facility is located on the Canaveral Air Force Station about 10 miles from the Orbiter Processing Facility (OPF) complex. This facility is used only by the GAS program which is of considerable value to the customer. The GAS payloads, at any given time, are either in the experimenter's hands or at the GAS Preparation Facility or in the Orbiter. A typical GAS payload integration is a cooperative affair between NASA and the experimenter lasting no more than three (3) days. Following canister closeout, GAS payloads remain in the GAS Preparation Facility until they are delivered to the Orbiter for installation.

The first mission to fly more than one payload was STS-6 launched on April 4, 1983, which carried three GAS payloads into orbit. They were G-005 (sponsored by the Ashai Shimbun of Tokyo, Japan), G-381 (sponsored by the /George W. Park seed Company of Greenwood, South Carolina), and G-049 (from the United States Air Force Academy in Colorado Springs, Colorado). The next mission, STS-7, launched on June 18, 1983, was the first large scale mission for the GAS program, carrying seven (7) GAS payloads into orbit. While STS-6 had been a challenge, STS-7 was a real test of the GAS team's ability to plan and conduct a relatively large scale field operation. Since the GAS Preparation Facility is only big enough to work on three payloads at a time, STS-7 was the first that the GAS team found it necessary to plan and conduct a flow of payloads through the facility. After the integration into the canisters, all seven payloads were stored at the GAS Preparation Facility until their scheduled installation into the Orbiter by the payload integration crew.

The design of the Motorized door Assembly (MDA) began soon after the commitment had been made. The design goal was to develop a mechanism that could be used either with or without a window while providing the largest opening possible. The first flight of the MDA occurred on STS-7, launched on June 18, 1983. The first GAS payload to use the MDA was G-305, sponsored by the United States Air Force, and designed, fabricated, and operated by the United States Naval Research Laboratory in Washington D. C. G-305 was an experiment which measured ultraviolet radiation. The experiment required that the door be opened and closed several times and was a good subject for the first use of the MDA. The MDA is available to the GAS customers as an extra cost option. The $7,000 fee charges for use of the MDA is intended to cover the costs of refurbishing the mechanism.

## III. GAS/EDUCATIONAL/INDUSTRY RELATIONSHIP

The GAS program works diligently to support every educational institution that is involved with the GAS program. Its intent is to foster as much enthusiasm in the younger generation and to provide an opportunity for an engineering experience that cannot be easily found. The GAS program deals with all levels of the educational spectrum, from the high school level to the graduate level. The program offers presentations and lectures to the educational communities along with the opportunity to visit the different facilities within the program, to see the actual carrier systems and to help in solving complex space related engineering problems.

The GAS program has also worked with private industry to suggest the possibility of the companies and organizations in supporting their local educational institutions in the sponsoring and the development of GAS payloads. It was soon found that a lot of companies have decided to sponsor payloads within the local communities, having competitive contests to deside the best experiment to sponsor. This approach has also been taken by some of our foreign customers by having nation wide contests to select payloads from its high school level students. It has worked in the past and hopefully will continue to work in the future.

The GAS program payloads are put into a three class system which is used to select payloads for flight: Class I being the Educational Class; Class II being the Private or Foreign Class; and Class III being the Government Class. At the present time the Educational Class, Class I, has 110 payloads in the queue, the Private and Foreign Class (Class II) has 125 in the queue, and the Government Class (Class III) has 51 in the queue. As stated before, the Educational Class deals with students from the high school level to the graduate level and from all over the world.

## IV. PAYLOAD PROCESSING

A conscious effort was made, as NASA began to work with more and more customers, to develop a review process that would allow NASA to efficiently monitor the progress of payloads as they moved through the various steps leading to flight certification. The final authority for the safety certification for all payloads is the Safety Review Board at JSC. The Safety Review Board has delegated the responsibility for the preliminary safety review to the GAS Project Office at GSFC. The end result being that the GAS experimenter has to deal only with personnel at GSFC for all of their technical concerns and the GAS Project Office deals with the JSC Safety Review Board on the experimenter's behalf. The GAS safety team maintains a close day-to-day working relationship with the JSC Safety Review Board personnel.

The GAS review process begins when the GAS customer mails their Payload Accommodations Requirements (PAR) to the Technical Liaison Office (TLO) at the GSFC. This is NASA`s first look at what the experimenter plans to do with his/her payload. Upon receipt of the PAR, the GAS TLO assigns a NASA Technical Manager (NTM) to the payload. The NTM is a NASA engineer or technician who will help move the payload through the review process, assist in preflight preparation at the launch site, and most important, provide a single point of contact to deal with the customer's Payload Manager. The GAS team reviews the PAR and a marked up copy is returned to the Payload Manager and a working telephone conference is scheduled. After the PAR is agreed upon by all parties the PAR is baselined and signed by the cognizant parties. Before the payload is certified for flight three (3) more reviews are performed: a Preliminary Safety Review, a Final Safety Review, and a Phase III Safety Review. These reviews are performed in a similar fashion (in sequence) and they are the process by which NASA comes to know the payload in ever increasing levels of detail. The whole process takes about 13 months from submission of the PAR to final signature of the Phase III Safety Data Package.

There are approximately 60 to 90 payloads likely to be under review at any given time. The GAS team at the GSFC reviews the progress of these payloads on a weekly basis in an attempt to see that the payloads proceed on their working schedules. As flight opportunities arise, payloads that are either certified for flight, or promise to have completed the review process before field operations begin, are considered for flight assignment and those payloads are manifested in accordance with the queuing rules specified by the GAS policy.

## V. ADDITIONAL CAPABILITIES

Ever since the earliest days of the GAS program, the response from those who would form the GAS community has been both heavy and constant. Initially, NASA originally planned to fly two GAS payloads on an adapter beam which would attach two payloads at a time to the Orbiter. As the number of payloads grew, concern began to arise over how to handle the backlog of payloads that were accumulating. It was decided to build a structure that would span the Orbiter cargo bay and provide the capacity to carry 12 GAS payloads. Known as the GAS bridge, this structure is intended to be able to take advantage of the opportunity presented when a major payload encounters problems and becomes unable to meet its scheduled launch date (see figure 2). NASA took delivery of the GAS bridge in September of 1984. Initial plans to fly the bridge for the first time were cancelled when NASA undertook the recovery of two satellites in November 1984. The first flight of the GAS bridge took place later on mission STS-61C in January 1986. A total of 13 payloads flew on that mission. Twelve payloads were mounted on the GAS bridge and the 13th was mounted on an adapter beam directly behind the bridge on the starboard side of the Orbiter.

After it was felt that enough GAS payloads had flown, in early 1984, to support an experimenter`s symposium. The GSFC in Greenbelt, Maryland, was chosen as the location. An announcement and call for papers was soon mailed and the first GAS symposium was held at the GSFC in August 1984. Since the first symposium was held at the GSFC, the GAS program has held a symposium each year at the GSFC, except for one that was held in 1988 at the Kennedy Space Center.

The proceedings published at the GAS symposiums serve as the historical record of the GAS program. Over the past five years over 300 students from all levels of education have attended the symposiums and some students that have graduated attribute the association with the GAS program as a motivator for their careers in engineering and science.

A significant new capablity, offered by the GAS program, is the ability to launch a small simple satellite from a GAS canister. Two satellites were placed in orbit in 1985. Supporting this capability two major hardware designs were required. One was a pedestal which supports the satellite and attaches to the lower end plate on a standard canister. The satellite is clamped to the pedestal by means of a Marman band which is released by an explosively actuated bolt cuters (see figure 3). The satellite is ejected by means of a spring loaded plunger, which releases the satellite at a rate of from 3 to 4 feet per second. In order to provide an unobstructed exit from the canister the MDA was modified to provide the maximum possible available diameter for the satellite. This modified MDA is now known as the Full Diameter Door Assembly (FDMDA) which is used only for satellite ejections. As in the case of the MDA, the GAS ejection system, which includes the launch pedestal and the FDMDA, is at an optional service charge.

## VI. THE FUTURE

The GAS program is now well established and is accumulating a fine history. Intended as a means to assist in using the Orbiter to capacity, and opening the doors to those who previously has no opportunity to work in space, the program has served those ends very well. Many young engineers and scientists who worked on GAS payloads as students are now employed by NASA, its contractors, and associated universities. New payload reservations are not being excepted at this time, but the GAS program is hoping to open the reservation door in the near future.

The hardware inventory of the GAS program is sufficient to handle multiple missions, and with an experienced support team throughout NASA and its contractors, and with experimenters steadily working their way thru the review and certification process, the GAS program stands ready to meet the new challenges and flight assignments that will come its way in the future.

## ACKNOWLEDGMENT

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## AUTHOR

George G. Gerondakis was born in Washington, D. C. on June 24, 1933. He received a Bachelor's Degree in Mechanical Engineering from the Catholic University of America, in 1980. From 1969 to the present he has been employed by the National Aeronautics and Space Administration at the Goddard Space Flight Center, Greenbelt, Maryland. He is currently the Get Away Special (GAS) Project Manager at the Goddard Space Flight Center.

FIGURE 1 – GET AWAY SPECIAL CANISTERS

NASA National Aeronautics and
Space Administration

G85-7830

Goddard Space Flight Center
Greenbelt, Maryland 20771

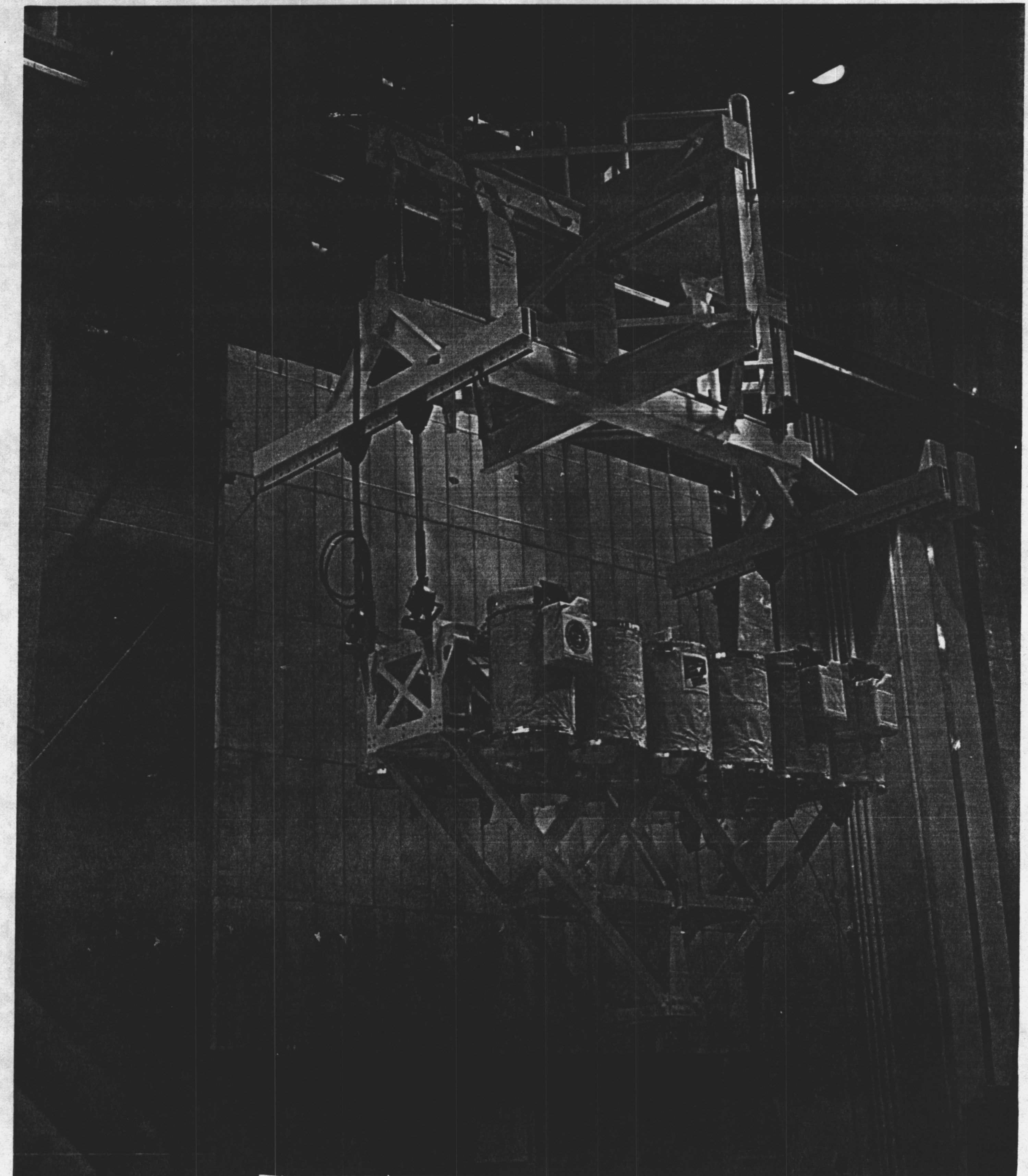

FIGURE 2 – GAS BRIDGE ASSEMBLY

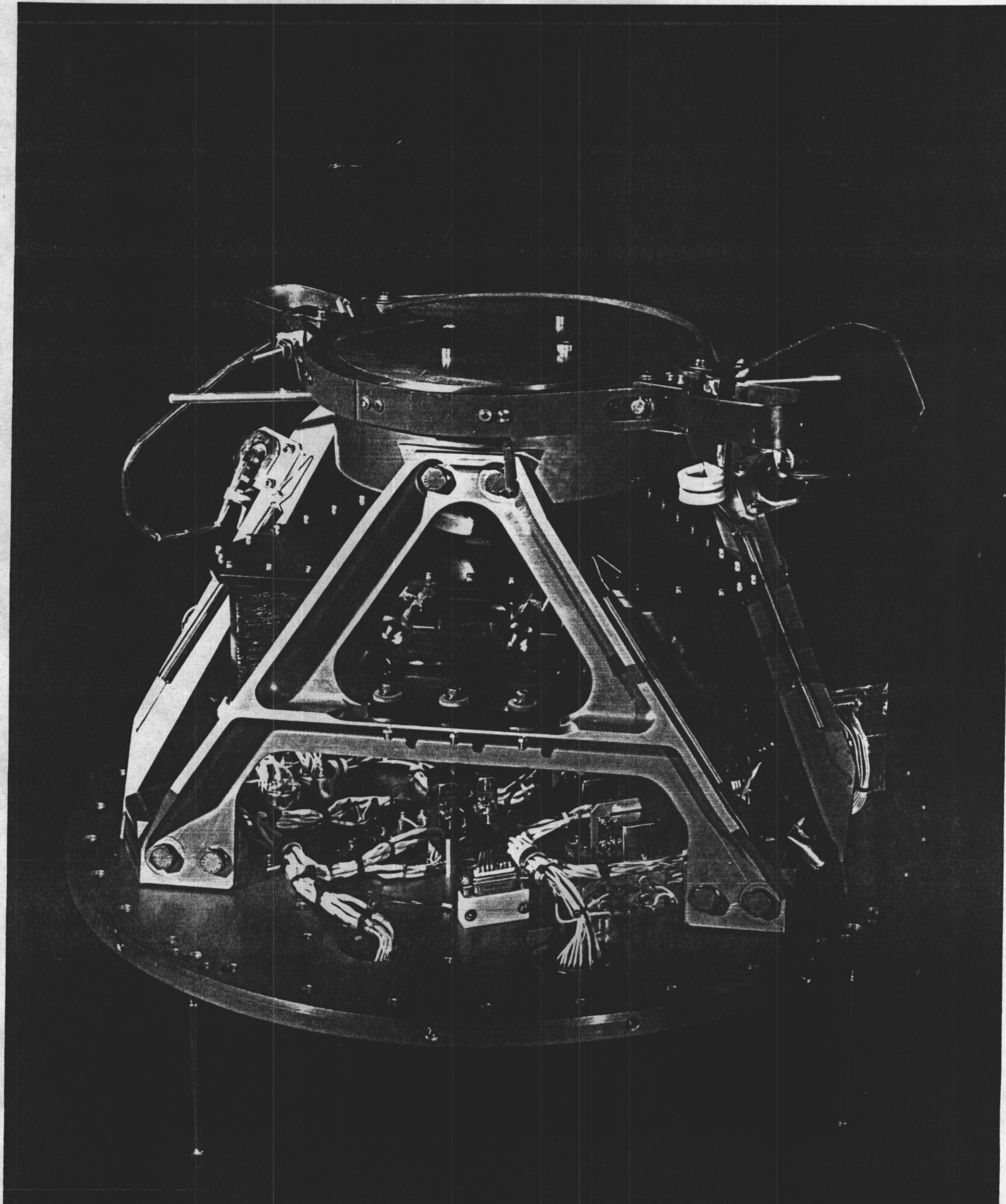

FIGURE 3 – GAS EJECTION SYSTEM PEDESTAL