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PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM

FINAL REPORT

BY

JOSEPH E. SWIDER, JR.

PREPARED UNDER CONTRACT NAS 9-12938

BY

HAMILTON STANDARD
DIVISION OF UNITED AIRCRAFT CORPORATION
WINDSOR LOCKS, CONN.

FOR

National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Houston, Texas 77058

April 1974

Hamilton Standard — DIVISION OF UNITED AIRCRAFT CORP

ABSTRACT

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This report describes the design studies, detail design activity, and ground and zero-gravity testing conducted in association with the development of a flight prototype waste collection subsystem for the Space Shuttle, and the verification of the performance of that system by both male and female crew members in a space environment (absence of gravity). This system was developed under contract NAS 9-12938, Preliminary Flight Prototype Waste Collection Subsystem, and is an outgrowth of the activity conducted under contract NAS 9-12150, Waste Collection Subsystem Development.

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FOREWORD

This report has been prepared by the Hamilton Standard Division of the United Aircraft Corporation for the National Aeronautics and Space Administration's Lyndon B. Johnson Space Center in accordance with the requirements of contract NAS 9-12938, Preliminary Flight Prototype Waste Collection Subsystem. The report covers the work accomplished during the period 1 July 1972 to 1 July 1974 in the development of the prototype system. The basic objective was to design, fabricate, ground acceptance test, and verify zero-gravity performance of the Preliminary Flight Prototype Waste Collection Subsystem.

Personnel responsible for the conduct of this program were Mr. F. H. Greenwood, Program Manager and Mr. J. E. Swider, Jr., Program Engineer. Appreciation is expressed to Mr. A. Boehm, Design Engineer and Mr. K. C. Jones, Human Factors Engineer of Hamilton Standard and Mr. A. F. Behrend, Technical Monitor for NASA-JSC, whose efforts made the successful completion of this program possible.

Appreciation is expressed to the personnel of the zero-g test sections at Wright-Patterson Air Force Base and NASA-JSC, with special thanks to Mr. Donald Griggs, Zero-g Test Director, for their outstanding support during the conduct of the zero-g test series.

A special note of appreciation is extended to the various test volunteers at Hamilton Standard, the volunteers from the USAF/AFLC Medical Center/HSN, Wright-Patterson Air Force Base, and the USAF Reserve Nurses and NASA-JSC volunteers utilized for system tests at Ellington Air Force Base. The outstanding cooperation of these volunteers during the conduct of the test programs helped to make this a successful program.

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SUMMARY

This program verified, by means of a series of zero-gravity tests, the ability of a complete Preliminary Flight Prototype Waste Collection Subsystem (WCS) to collect waste products from crew members in a spacecraft environment. The test results show that the system as designed is capable of collecting urine and feces from both men and women, utilizing a method resembling conventional earthlike usage. The system does not require the manual handling of any waste products, nor does it require intimate contact between the user and any part of the equipment, other than the commode seat. The system also demonstrated its ability to handle post-elimination wipes without difficulty. The designs utilized in the WCS were verified as acceptable for usage in the Space Shuttle or other space vehicles.

This program was initiated after successful completion of the Waste Collection Subsystem Development Program, contract NAS 9-12150. The initial activity was to zero-gravity test the seat and urinal concepts and vortex separator concept developed under NAS 9-12150. This flight program, conducted aboard an Air Force KC-135 aircraft based at Wright-Patterson Air Force Base, utilized both male and female test volunteers. The zero-gravity program demonstrated the feasibility of collecting urine from both male and female crew members in a zero-gravity environment, in an earthlike manner not requiring any manual handling of urine containers. In addition, the testing verified that a seat, comfortable both on the ground and in zero-gravity, could be designed. The tests also showed that the vortex liquid/air separator is an effective liquid/air separation method in zero-gravity. Two 16 mm films were prepared illustrating the results of this zero-gravity test series.

The effort then was directed toward design and fabrication of a flight prototype WCS. The information gained in the earlier development program and the zero-gravity test program was utilized to build a complete WCS. This system incorporated a minimum flow 7.08×10^{-3} m^3/s (15 scfm) multi-positional urinal, a feces collection scheme using 9.44×10^{-3} m^3/s (20 scfm) to separate and transport feces, wipe retention devices in the feces storage/processor, a biocide system using a silver chloride column, an user positioning-jet system, odor and bacteria filters, a vortex liquid/air separator, an urinal flush system, a waste liquid storage system and the required valves to vacuum dry feces.

A 42 man-day user acceptance test was conducted on the complete WCS by male and female test volunteers. The system functioned without difficulty. Inspection of the commode after use found that the wipe retention devices worked well in controlling distribution and packing of the wipes. The vacuum drying of the feces again was effective. The unit was cleaned utilizing a cleaning drain installed in the bottom of the commode, establishing the feasibility of developing an in-place cleaning method for the commode. The unit then was readied for shipment to NASA-JSC for zero-gravity testing of of the entire WCS.

Total system tests of the Preliminary Flight Prototype WCS were conducted aboard the NASA zero-gravity test aircraft based at Ellington Air Force Base. Sixteen test volunteers (13 female and 3 male) utilized the system for both urination and defecation. The Waste Collection Subsystem verified in zero-gravity its ability to collect waste products from all users. The test volunteers found the system earthlike in usage and easy to use. One problem area was discovered, namely that the urinal needed more range of movement in the male position. Otherwise, the test volunteers preferred this non-intimate contact urinal, liked the hard contoured commode seat and the three-way restraint system. The test volunteers thought the positioning jet a good training aid but not required once the user became accustomed to the system. The wipe retention devices worked well in zero-gravity in retaining and distributing wipes, and the vortex liquid/air separator and odor control system were effective. A 16 mm film was prepared illustrating the salient points of the zero-gravity tests.

The Preliminary Flight Prototype WCS performed without failure and all program objectives were met successfully. The design concepts fabricated and tested have been verified to be functional, acceptable designs and these concepts are ready for direct incorporation into the Space Shuttle and other space vehicles.

INTRODUCTION

The requirements for Space Shuttle waste management are new and unique to space flight. Past manned space flight systems have been driven by limited space and weight available for waste management functions and the use of highly motivated, highly trained astronauts. Research conducted on advanced systems has dealt primarily with space station type missions with emphasis on reclamation equipment and relatively little emphasis on the man-machine interface equipment.

As a result NASA initiated the Waste Collection Subsystem Development Program, contract NAS 9-12150, to address a number of the important waste management problems which had not yet received attention. These were:

- Earthlike equipment, without intimate contact between the urinal and the user.
- Elimination of manual handling of waste products.
- Waste collection from female crew members.
- Collection of simultaneous urination and defecation in separate collectors.
- Combined ground and zero-gravity operation.
- Simplicity of operation.

The development waste collection subsystem designed and fabricated under NAS 9-12150 successfully demonstrated, based on ground testing, the feasibility of a system that met all requirements and solved the aforementioned problems (ref. NASA document No. CR 133977).

As a result of the success of contract NAS 9-12150 the NASA initiated contract NAS 9-12938, Preliminary Flight Prototype Waste Collection Subsystem. The initial phase of this contract was to conduct zero-gravity tests of the seat/urinal and liquid/air separator developed under NAS 9-12150, with particular attention paid to optimization of earthlike urine collection from male and female users in the zero-gravity environment. The data then was utilized to design and fabricate a prototype WCS having a degree of sophistication that truly represented a flight prototype system but allowed the use of commercial-grade hardware, thus minimizing costs without compromising program objectives.

Once the unit was fabricated a 42 man-day user acceptance test was conducted at Hamilton Standard to verify operation and functional usability. At the completion of the acceptance test the Preliminary Flight Prototype Waste Collection Subsystem was shipped to NASA-JSC and installed on the NASA zero-gravity test aircraft. A comprehensive series of zero-gravity tests utilizing sixteen male and female test volunteers was conducted. The test program verified the ability of the Preliminary Flight Prototype Waste Collection Subsystem to collect all waste products from all users in a simple, efficient, earthlike manner in a spacecraft environment.

CONCLUSIONS

The results of this program effort to design, build, and verify by zero-gravity tests a Preliminary Flight Prototype Waste Collection Subsystem have led to the following conclusions:

- The design of the Preliminary Flight Prototype Waste Collection Subsystem as tested is an effective, acceptable waste collection system for spacecraft usage for both male and female users.
- The vacuum drying process utilized for feces processing performed well and exhibited excellent performance in drying the feces.
- The wipe retention devices effectively solved the problem of retaining and distributing post-elimination wipes for packing within the commode.
- Separate collection of urine and feces is practical with a sit-down type collector.
- The hard contoured commode seat was found comfortable by all users in both one-g and zero-g.
- The three-way restraint system (foot, lapbelt, and hand holds) was found effective and necessary for proper user control in the zero-gravity environment.
- The feces entrainment airflow of 9.44×10^{-3} m^3/s (20 scfm) was found adequate to separate and transport the stool to the storage processing unit in zero-gravity.
- The 0.1 m (4.0 in.) diameter fecal collection opening and transfer duct were found acceptable for usage. Minimal soiling occurred in these areas and soiled areas were easily cleaned.
- The user positioning jet was found to be an effective training aid but the test volunteers did not think it was required for a flight system. The test volunteers thought the hard contoured seat, in combination with experience, adequately positioned the user.
- The feasibility of cleaning the commode in place through a cleaning drain was demonstrated. Additional effort is required to develop the aerospace ground equipment (AGE) to accomplish this task.
- The commode capacity was not taxed at all during the test program and is well in excess of 150 man-days of feces and wipes.

- Urine collection with a non-intimate contact urinal utilizing a urinal air entrainment flow of 7.08×10^{-3} m^3/s (15 scfm) (4.72×10^{-3} m^3/s (10 scfm) primary and 2.36×10^{-3} m^3/s (5 scfm) induced rear flow) was successful in zero-gravity, verifying the feasibility of this approach.

- The multi-positional urinal detent position for females was excellent for female users; the male position requires further variability to attain the optimum male urinal attitude.

- The urinal flush requires a water pressure of $3.08 \times 10^5 N/m^2$ (30 psig) to be effective in zero-gravity with the urinal cover closed and the entrainment air flow of 7.08×10^{-3} m^3/s (15 scfm). 9.1×10^{-2} kg (0.2 lbs) was required to get effective urinal cleaning.

- The debris screen downstream of the urinal is required for catching items inadvertently dropped into the urinal.

- Odor control by activated charcoal and "Purafil" filters is feasible.

- The silver chloride column and precharge of silver nitrate in the storage tank were effective in inhibiting odors from the urine system and storage tank during the 42 man-day acceptance test.

- The vortex liquid/air separator was effective in separating the liquid/air mixture in zero-gravity.

RECOMMENDATIONS

The results of this program evolved the following recommendations:

- The basic design features of the Preliminary Flight Prototype Waste Collection Subsystem commode assembly should be incorporated into any Space Shuttle or other space vehicle waste collection subsystem. Basically these features are as follows:
  - Vacuum drying should be utilized as the feces processing method.
  - Wipes should be used for post-elimination cleansing with wipe retention devices installed to control distribution and packing within the commode.
  - A hard contoured seat should be utilized to support the user.
  - A three-way restraint system including the feet, lap, and hands, should be available to the user.
  - The feces air entrainment flow should be 9.44×10^{-3} m^3/s (20 scfm).
  - The urinal should be a non-intimate contact, multi-positional urinal. Entrainment airflow required for this concept is 7.08×10^{-3} m^3/s (15 scfm).
- The positioning jet is not necessary for system operation, but may be considered as a training aid.
- Odor control of the waste management subsystem should be accomplished by passing airflows through a filter package consisting of activated charcoal and "Purafil".
- The commode volume should be idealized for each application's particular man-day requirement but the basic features of the commode and slinger should be retained.
- Additional study, design and test efforts should be performed in the following areas:
  - The overall techniques and AGE necessary to effect in-place cleaning of the commode should be developed.
  - The overall approach to urinal cleansing and the biocide to be used should be optimized for the vehicle system, considering items such as the urine storage period and connection to a vehicle water supply.

DISCUSSION

The discussion of the results obtained from this program is divided into four major task areas: Development Unit Seat/Urinal Zero-Gravity Tests, Preliminary Flight Prototype Waste Collection Subsystem Design, Preliminary Flight Prototype Acceptance Tests, and Preliminary Flight Prototype Zero-Gravity Tests. These major tasks, corresponding to the program work breakdown structure, have several associated subtasks, each of which is discussed in detail.

DEVELOPMENT UNIT SEAT/URINAL ZERO-GRAVITY TESTS

The zero-gravity tests conducted early in the Preliminary Flight Prototype Waste Collection Subsystem contract were accomplished to verify the acceptability of the seat, urinal and liquid/air separator developed under contract NAS 9-12150 to operate in a zero-gravity environment. Particular attention was paid to the earthlike collection of urine from females and males in the zero-gravity environment.

The testing was conducted on the Air Force Zero-Gravity Test Aircraft operated from Wright-Patterson Air Force Base. The detail results of the flight test program are presented in Hamilton Standard Report SVHSER 6181, Preliminary Flight Prototype Waste Collection Subsystem Zero-Gravity Test Report. In addition, two 16 mm edited films with photographic data recorded during the test program are an integral portion of the test report and must be viewed for a full understanding and evaluation of the test results.

Summary and Conclusions

The zero-gravity test program conducted early in this contract demonstrated the feasibility and practicability of collecting urine from both male and female crew-members in a zero-gravity environment in an earthlike manner not requiring any manual handling of urine containers. In addition, the testing demonstrated that a seat which is comfortable in both regimes of operation could be designed for use both on the ground and in zero-gravity. Further, the tests showed that the vortex liquid/air separator is an effective liquid/air separation method in zero-gravity. Visual observations indicate essentially zero liquid carry-over.

The following were the specific test objectives for this test program.

- Evaluate the ability of the seat and urinal developed under contract NAS 9-12150 to collect urine from females under zero-gravity conditions

and optimize this design to establish the best equipment configuration and minimal air entrainment flows required.

- Determine the collection capability and minimum air entrainment flows required for male urine collection when using the configuration suitable for female urine collection.

- Establish and optimize the performance in a zero-gravity environment of the vortex liquid/air separator developed under contract NAS 9-12150.

- Determine the effectiveness of urine collection from male and female crew-members with no air entrainment flow.

The urinal and seat test program was accomplished using first a specially designed female manikin (Gynny, pelvic teaching model, sold by Ortho Pharmaceutical Corp., Raritan, New Jersey 08869; manufactured by Alderson Research Labs, Inc., 390 Ludlow Street, Stamford, Connecticut 06095) and subsequently, employing both female and male test subjects. The female test subjects were eight Air Force nurse volunteers stationed at Wright-Patterson Air Force Base, from where most of the flight test program was conducted. The male subjects were two Hamilton Standard engineers.

The test objectives were not totally completed because the aircraft was not available for a sufficient period of time. Testing of the vortex liquid/air separator was essentially completed. Female and male collections were accomplished and air entrainment flows were reduced to about 60 percent of those previously established. However, fine tuning of the air entrainment flows, ultimate optimization of the design configuration, determination of minimum air flows required for male usage and effects of collection without any air entrainment flow were not accomplished.

The test data, however, did verify the feasibility of the components tested and sufficient data was obtained to allow design of the Preliminary Flight Prototype Waste Collection Subsystem to proceed. The test program led to the following specific test results and conclusions:

- The urinal configuration developed under contract NAS 9-12150, depicted in figures 1 and 2, is effective in the collection of urine from female as well as male crew-members in a zero-gravity environment.

- The effective collection of urine from female crew-members requires two distinct air entrainment flow streams; a primary stream drawn down between the thighs into the vulva area and a secondary stream of backflow, which is blown or drawn up onto the vulva area from the rear of the urinal.

- Effective urine collection using the specific urinal design configuration tested, can be obtained from female crew-members at a primary air entrainment flow of 3.07×10^{-2} m^3/s (65 scfm) and a secondary flow (backflow) of 4.72×10^{-3} m^3/s (10 scfm). Prior to the zero-gravity testing these flows had been set at 4.72×10^{-2} m^3/s (100 scfm) and 1.41×10^{-2} m^3/s (30 scfm) respectively.

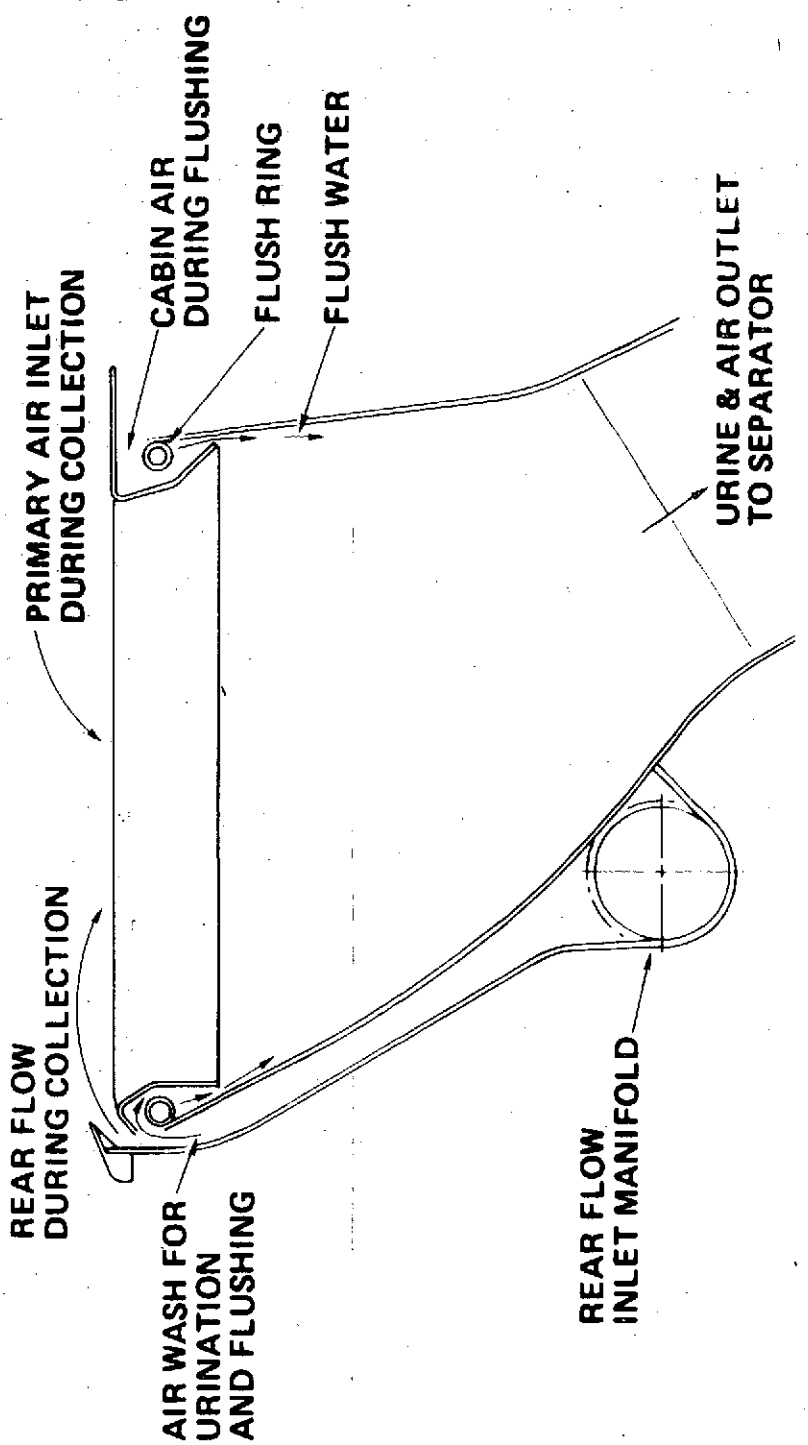

FIGURE 1. URINAL CONFIGURATION TESTED, SEAT/URINAL ZERO-GRAVITY TEST SERIES (CROSS SECTION)

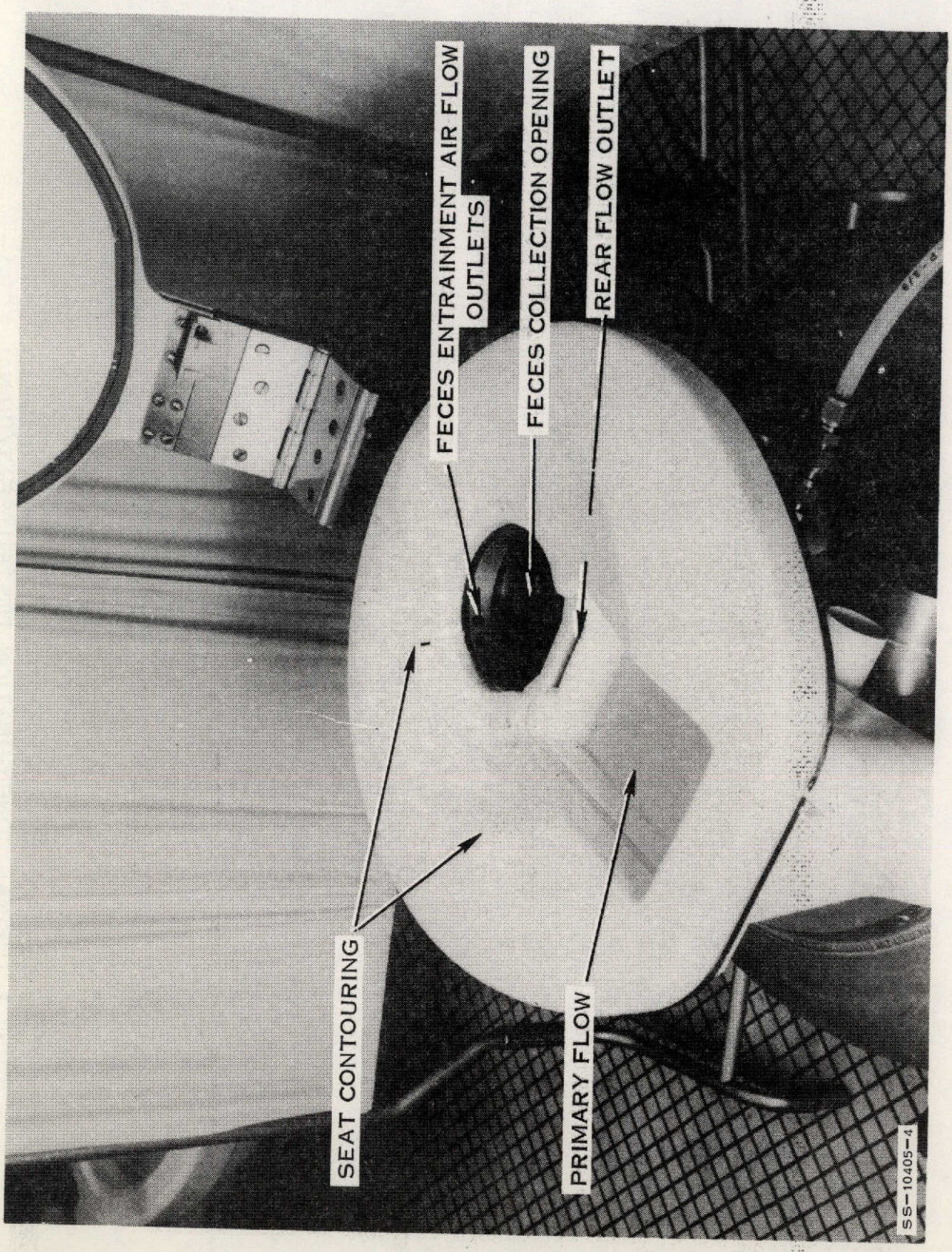

FIGURE 2. URINAL/SEAT CONFIGURATION TESTED, SEAT/URINAL ZERO-GRAVITY TEST SERIES

- Male urine collection without backflow and with the minimum primary flow required for female collection is accomplished without difficulty. Collection also was accomplished with backflow and no undesirable effects were obtained.

- The micturitions recorded during the flight test series were significantly different from those expected based upon ground studies; specifically, the absence of a high velocity stream during large quantity voids. The test volunteers in several cases expressed a normal or strong urge to void during the test series, however, the expulsion velocity, as evidence by the films and test volunteer opinion, was reduced over that experienced on the ground at one-g.

- The position of the test volunteers varied greatly throughout the test series and in many cases the test volunteers were considerably out of position during micturition. It is believed that much of the poor positioning was imposed by aircraft turbulence, caused by the aircraft flight maneuvers required to obtain zero-gravity, and by the test volunteers' unfamiliarity with the test equipment, caused by the limited amount of tests conducted. The use of the available positioning jet would have been helpful during this test series.

- The foot restraints and hand holds utilized during the zero-gravity testing were effective for zero-gravity usage of the urinal. However, it was concluded that a lap belt to help restrain and maintain the position of the test volunteer during aircraft turbulence and maneuvering would be useful for future testing on the zero-gravity test aircraft.

- The seat design, which supports the user at the ischial tuberosities, was found to be very comfortable by the test volunteers in zero-gravity, on the ground, and during the aircraft pullouts where 2 to 2.5 g's were experienced. Figure 2 depicts the seat configuration used during this test series.

- A female manikin proved to be an effective tool in providing information on urinal airflow and liquid control capability prior to actual usage by test volunteers. While not providing exact duplication of micturition by female volunteers the simulation was representative enough to reveal the points where collection performance becomes marginal.

- The vortex liquid/air separator met its performance goal of no visible liquid carry-over throughout the performance range tested and is an effective zero-gravity liquid/air separation device. Several areas where minor design changes would allow improved operation were revealed. Figure 3 depicts the vortex separator as installed for zero-gravity testing.

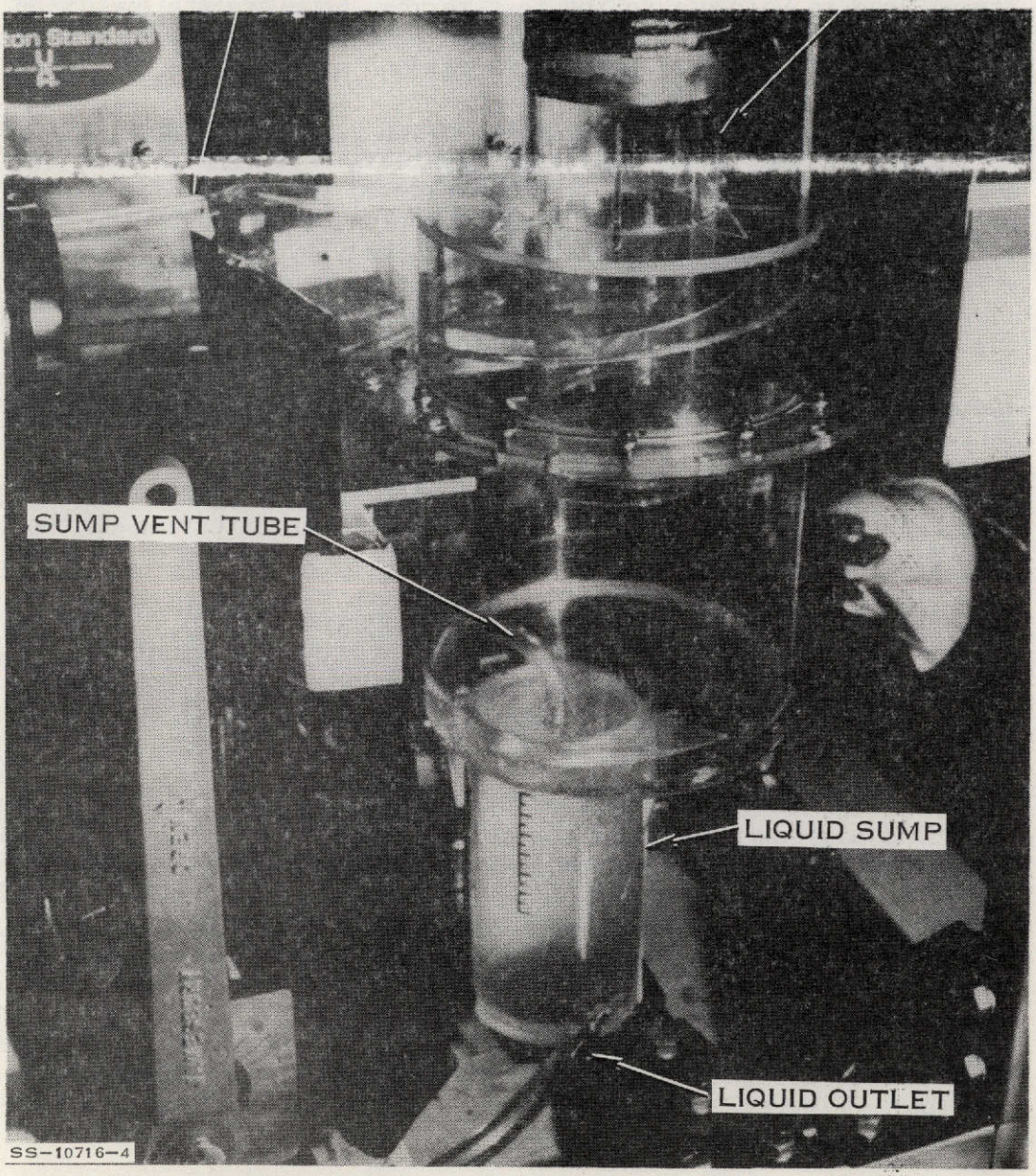

FIGURE 3. VORTEX LIQUID/AIR SEPARATOR TESTED, SEAT/URINAL ZERO-GRAVITY TEST SERIES

- Due to the limited number of flights that were available to conduct this test series total optimization of the urinal was not accomplished. It was recommended that future testing be considered to allow evaluation of size reduction of the urinal, determination of minimum airflow for male usage, and further investigation into female positioning and into the reduced expulsion pressure phenomenon previously discussed.

- Generally, the test program met all contractual requirements and provided sufficient information to allow design of the Preliminary Flight Prototype WCS. Additional testing would have been desirable from the standpoint of further enhancing the urinal concept and gaining additional information on the micturition process.

Discussion of Test Results

A special zero-gravity test fixture was manufactured for this test series. Figures 4, 5 and 6 show the urinal and seat installation and the test console with the vortex separator installed. The total test system is defined by Hamilton Standard drawings SVSK 86041, SVSK 86042 and SVSK 86043. Figures 7 and 8 depict the total installation in the zero-gravity test aircraft including the privacy enclosure provided for the test volunteers. Figure 9 shows the camera positions utilized for the urinal testing and the support for the female manikin simulator, and figure 10 illustrates the camera positions used for vortex separator testing. All test data was recorded photographically with cameras located as shown in figures 9 and 10. In addition, a hand held camera was used to record any aspects of the testing not being recorded by the fixed position cameras.

The primary means of obtaining and understanding the test results is by viewing the photographic data recorded during the flight testing. Two 16 mm films were prepared for viewing. One film depicts the urinal testing and is divided into two parts; part one presents the female manikin testing and part two presents the subjective testing. The second film presents the vortex liquid/air separator testing. The other means of obtaining data during the test program was by means of subjective comments from the test volunteers and test observations by the test conductors. Appendix A of this report contains an example of the data sheets utilized by the test volunteers and a tabulation of the pertinent comments.

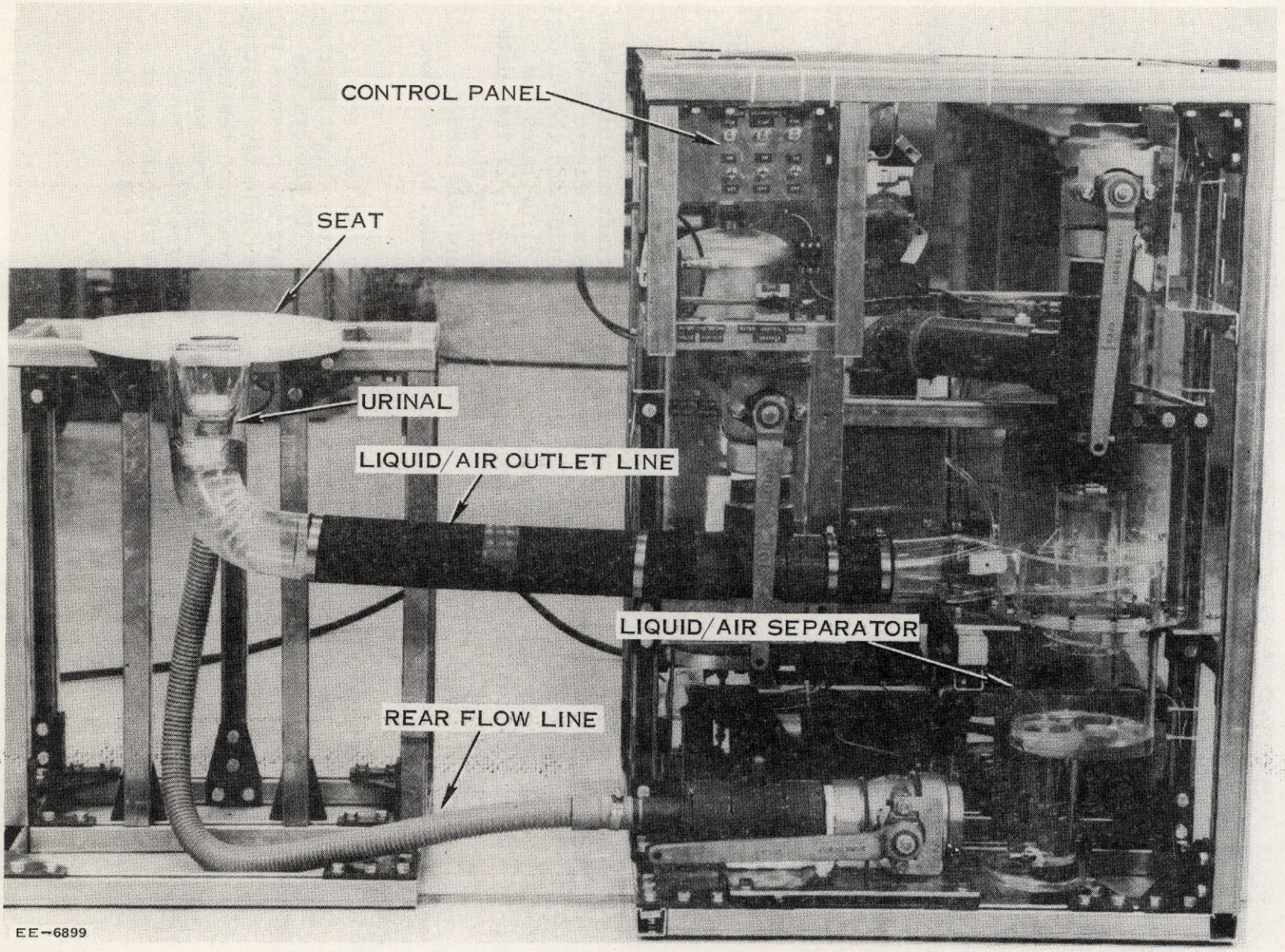

FIGURE 4. ZERO-GRAVITY TEST EQUIPMENT-FRONT VIEW

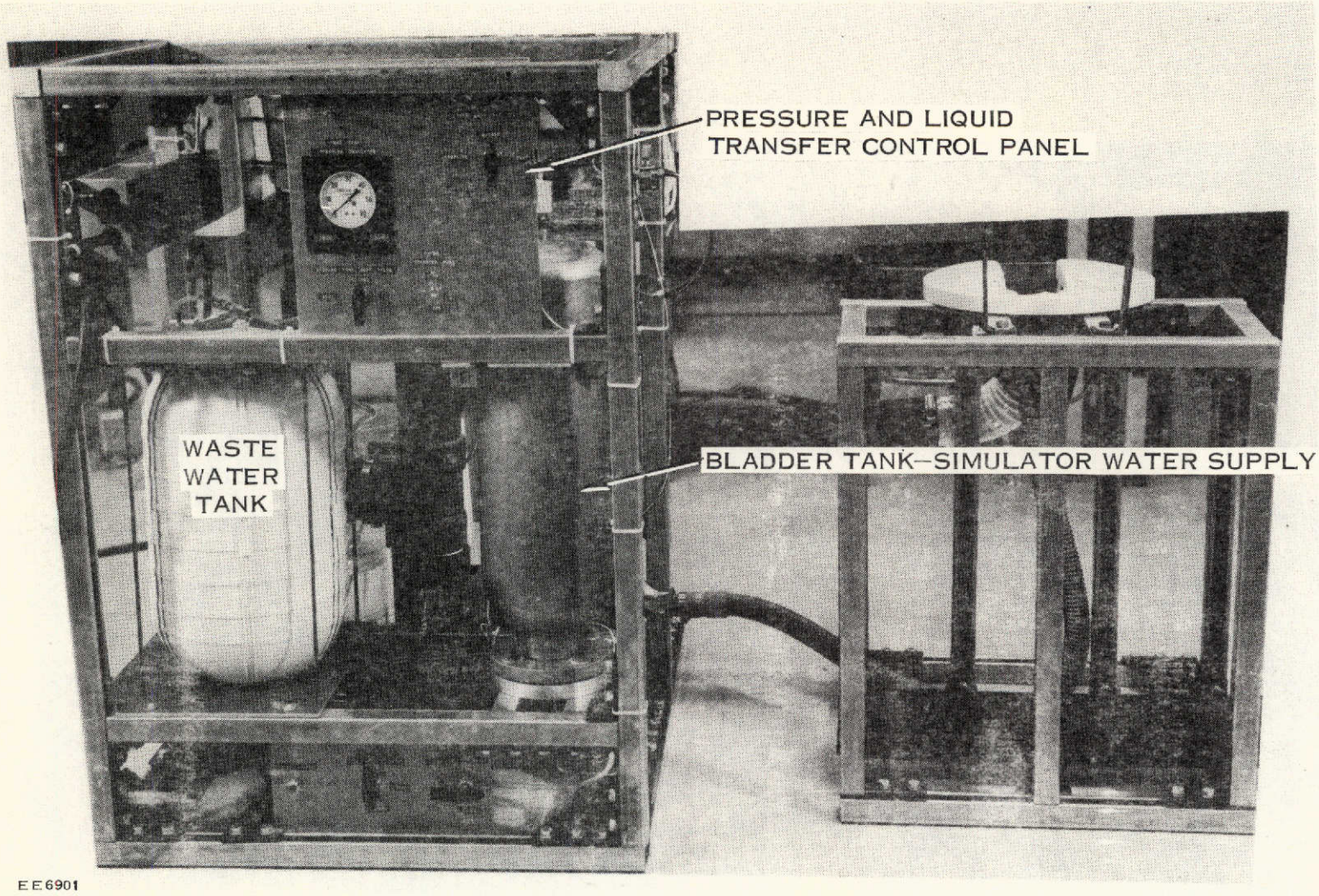

FIGURE 5. SEAT/URINAL ZERO—GRAVITY TEST EQUIPMENT—REAR VIEW

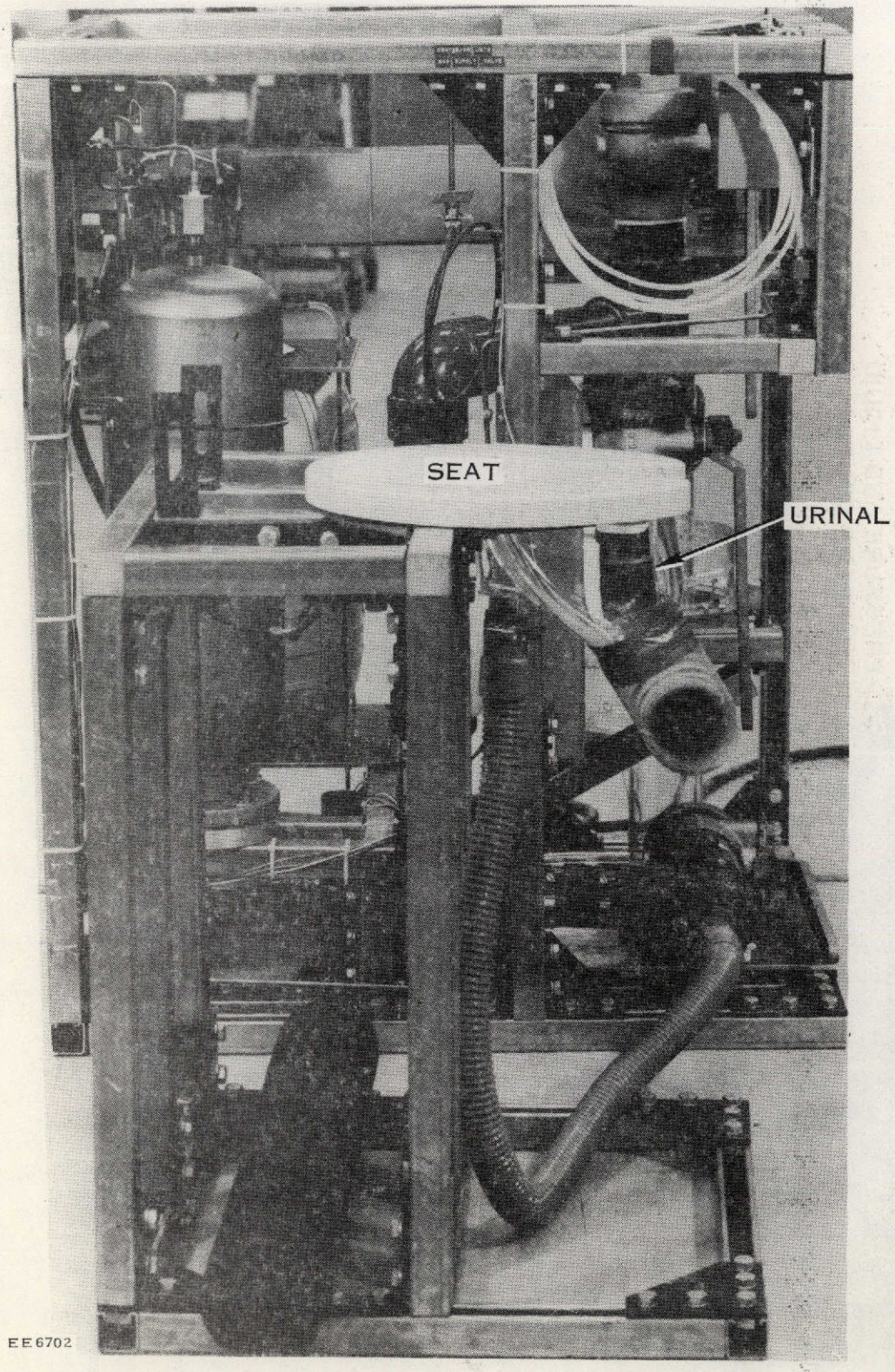

FIGURE 6. SEAT/URINAL ZERO-GRAVITY TEST EQUIPMENT-SIDE VIEW

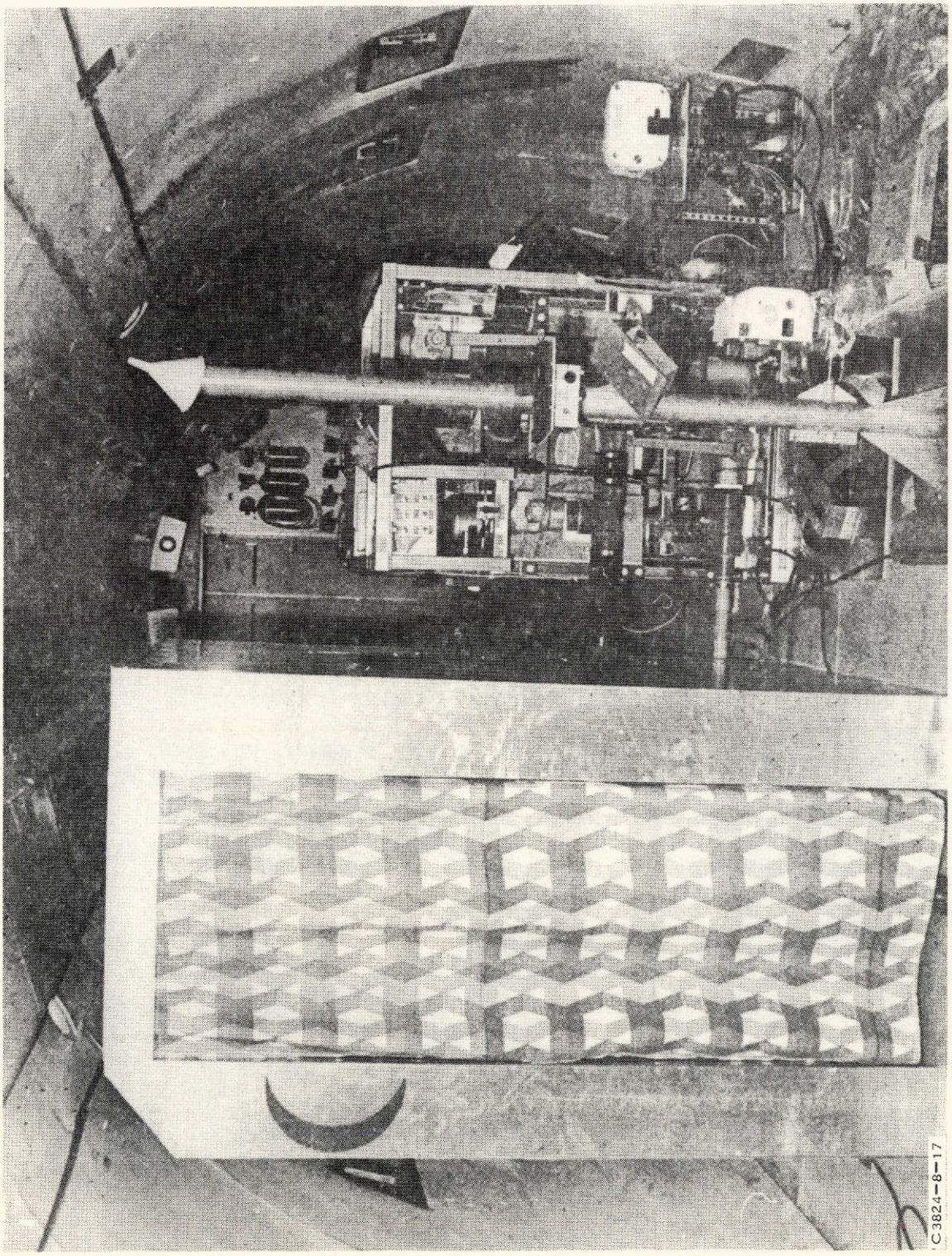

FIGURE 7. SEAT/URINAL ZERO-GRAVITY TEST EQUIPMENT INSTALLED IN TEST AIRCRAFT FRONT VIEW

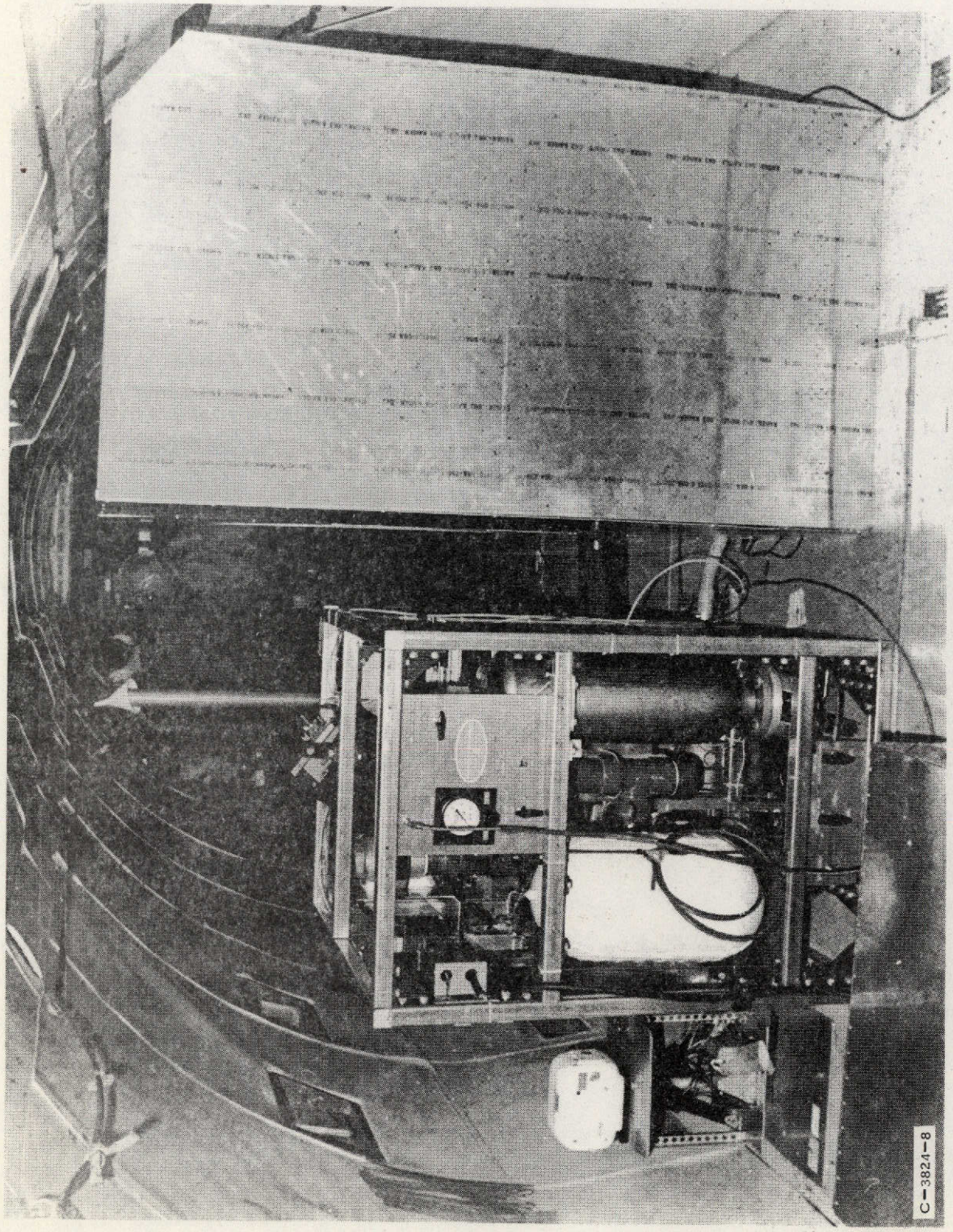

FIGURE 8. SEAT/URINAL ZERO-GRAVITY TEST EQUIPMENT INSTALLED IN TEST AIRCRAFT REAR VIEW

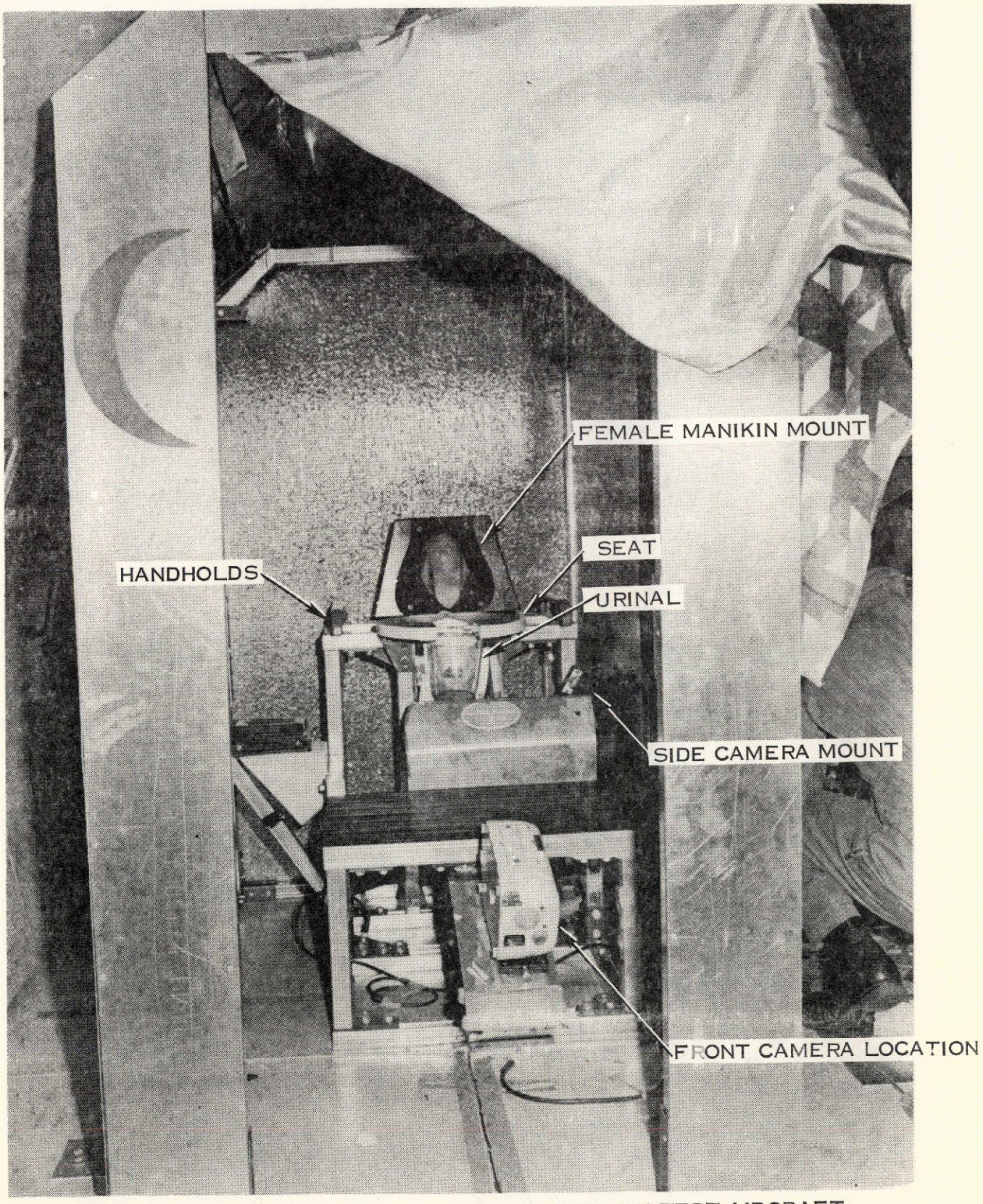

FIGURE 9. URINAL TEST SETUP IN ZERO-GRAVITY TEST AIRCRAFT (NOTE CAMERA LOCATIONS AND FEMALE MANIKIN MOUNTING)

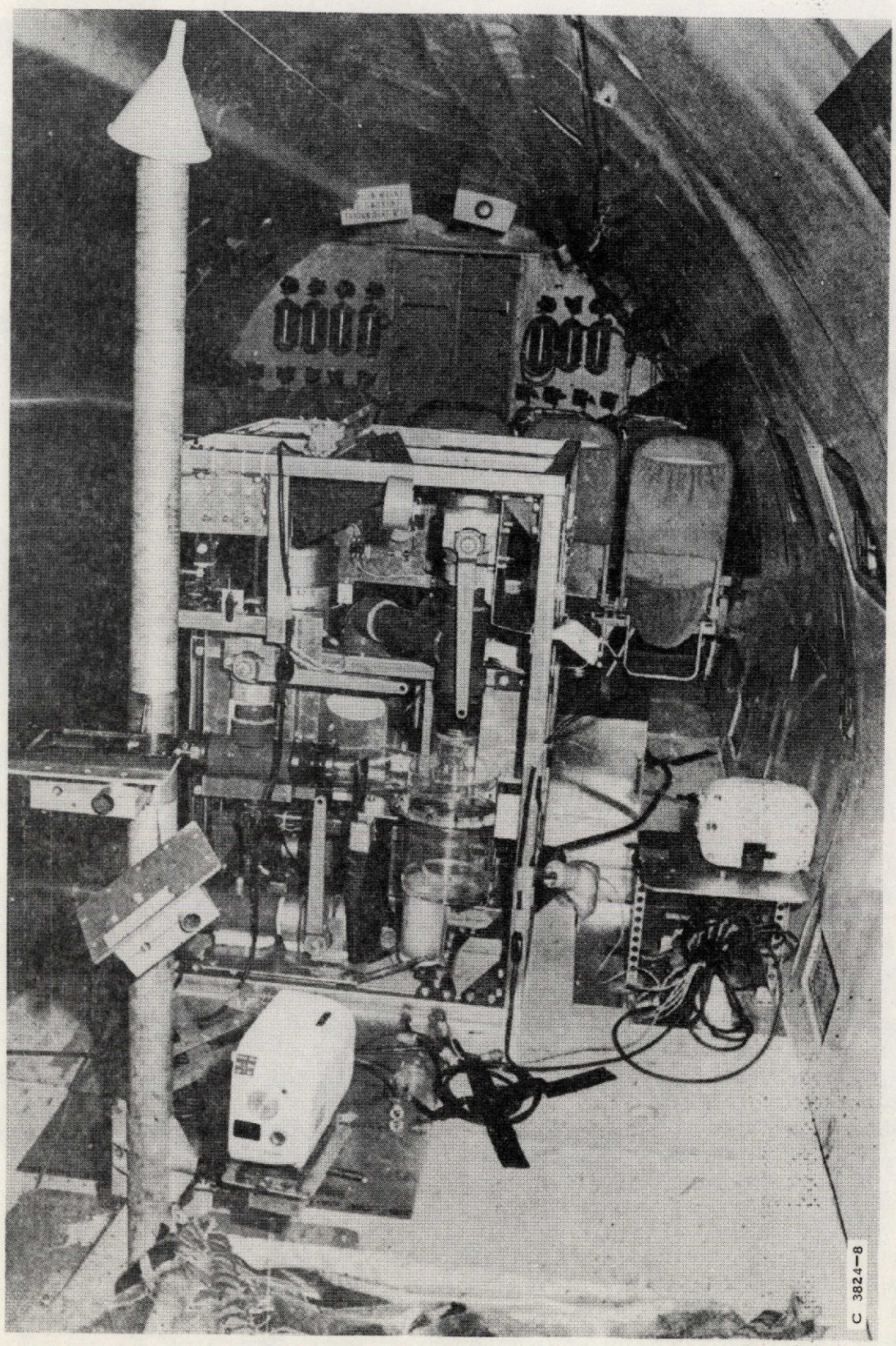

FIGURE 10. LIQUID/AIR SEPARATOR TEST SETUP IN ZERO-GRAVITY TEST AIRCRAFT (NOTE CAMERA LOCATIONS)

Seat/Urinal Tests

The testing conducted provided positive results with respect to the feasibility of collecting urine from male and female crew-members in a zero-gravity environment in an earthlike manner. As indicated by the subjective comments contained in Appendix A, the test volunteers offered almost no negative comments regarding the equipment and reported very few instances of splashing, lack of collection or urine pooling. The greatest effect on collection noted when actually analyzing the film data was the position of the test volunteers. The test volunteer reporting the greatest difficulty with collection also tended to totally block entrainment flow by sitting too far forward and also closing her thighs. In this case and others similar to it, the effective flow rates were estimated to assist in arriving at viable conclusions. Using this approach, in combination with the results presented by cases where the test volunteers were properly positioned allows the determination of final air entrainment flows. The design flow conditions, which had been established by the analysis and test activity conducted in NAS 9-12150, were 4.72×10^{-2} m^3/s (100 scfm) primary air flow and 1.41×10^{-2} m^3/s (30 scfm) backflow providing 9.144 m/s (30 ft/sec) air velocity in the vulva area. It was concluded, as a result of this test activity, that for the design configuration tested the primary flow could be reduced to 3.07×10^{-2} m^3/s (65 scfm) and the backflow to 4.72×10^{-3} m^3/s (10 scfm) providing a 6.096 m/s (20 ft/sec) velocity in the vulva area. The backflow angle defined was 45°.

The zero-gravity testing confirmed the need for backflow. During the manikin testing with high liquid flow rates and the urethra in the most forward position backflow had little or no effect. Voids duplicating the end of a female micturition did require the backflow to keep the liquid from flowing back over the perineal area. When the urethra was in the aft position, backflow again had little effect on the high velocity, high liquid flow rates (45 ml/sec). However, at liquid flow rates below 20 ml/sec the backflow definitely prevented pooling and rearward movement of the liquid.

The same results were evident with the female test volunteers. When the volunteers blocked the backflow opening by poor positioning, globules built up in the vulva area and the urine tended to cause contamination of the buttocks and spread throughout the vulva area. When the backflow was present, the urine pooling in the vulva area was small and urine was carried from the vulva area by the backflow.

It was concluded from the test films and discussions with the test volunteers that the primary problem involved with positioning of the body was the characteristics of the testing imposed by the aircraft and the short amount of actual test time available, which did not allow the test volunteers to become thoroughly familiar with using the equipment. The test volunteers reported that between trying to concentrate on micturating on cue, adjusting themselves at the same time after experiencing the 2 to 2.5-g pullout, and aircraft turbulence they did not have time to concentrate on position but

just the actual micturition. A positioning jet was available but was not utilized because the female volunteers were concerned primarily with micturating. The test volunteers were improving their positioning as they got familiar with the overall aspect of micturating on command, aircraft characteristics and turbulence, and were attempting to concentrate more on position at the time when the test program was terminated.

Only one male micturition was accomplished during the test series because the female collection was deemed more important within the limited test time available. The male micturition was accomplished at minimal female airflow condition, 2.93×10^{-2} m^3/s (62 scfm) without difficulty. The establishment of minimum entrainment airflow for male collection with the urinal configuration utilized was not accomplished due to termination of the testing.

The foot restraints and hand holds were found to be effective restraint devices during zero-gravity operation. However, it is believed that some type of loose restraint in the waist area could be helpful during aircraft testing to avoid large displacements of the test subjects in turbulent and negative gravity conditions.

The test subjects had no negative comments regarding the seat configuration. The seat was found comfortable during one-g, 2 to 2.5-g, and zero-gravity operation. The concept of supporting the user at the ischial tuberosities will be continued in future seat designs.

During the evaluation of the zero-gravity films a characteristic low urine expulsion velocity was noted. The phenomenon appears consistent for all recorded occurrences regardless of subject anatomy or the total urine quantity voided. Discussions with the test volunteers revealed that the normal urge to void was present and in fact, in some instances a strong urge was present, possibly due to the high "g" forces experienced during each parabola. From a physiological standpoint, distension of the bladder with urine causes an increase in bladder wall tension and the urine expulsion velocity is proportional to this tension. A possible explanation for the phenomenon experienced is that the fluid weight in the bladder usually acts as the normal initiation force upon the floor of the bladder triggering and maintaining the void reflex in the bladder and urethra. The fluid volume in the bladder creates the distension which results in the urge to void; however, in the zero-gravity environment the absence of the weight vector reduces the necessary initiation force and could result in the lower expulsion velocity. This phenomenon has been noted in bed ridden patients where the force vector is reoriented, the urge to void is present, but the velocity is not. Further investigation of this phenomenon might be of interest.

The testing also verified the ability to evaluate the collection of urine from females by use of the female manikin. The great variation in position experienced could not be readily duplicated with the manikin but urine

flow rate, expulsion velocity and various urethra positions were shown to be reasonable representations of actual female micturition characteristics. The manikin therefore, represents an attractive device to evaluate any major changes in urinal design or airflows and can give an indication of the design's feasibility prior to use by test volunteers.

Liquid/Air Separator Tests

The vortex liquid/air separator evaluated during this test series met all its test objectives. Inspection of the photographic data revealed that the separator did not allow any visible liquid carry-over at airflows between 2.93×10^{-2} and 6.07×10^{-2} m^3/s (62 and 129 scfm) and associated liquid flow rates between 5 and 45 ml/s. In addition, no liquid carry-over was noted by the test personnel during urinal testing at airflows down to 2.17×10^{-2} m^3/s (46 scfm) and liquid flows down to 0.75 ml/s. Based on the testing, several minor design changes were defined to further improve the vortex separator characteristics. These are:

- The sump entrance will be rotated to allow a smoother entrance from the upper portion of the separator into the sump.
- The sump vent tube will be shortened to prevent interference with the liquid flow along the separator wall.
- Improvement will be made in the entrance area of the separator so that the liquid entering the separator will not splatter and cause drops to remain in the upper portion.

The aforementioned conditions are illustrated in the zero-gravity film of separator performance.

PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM DESIGN

The preliminary flight prototype design activity consisted of two major activities, establishment of the design requirements and then the actual detail design of the subsystem.

Space Shuttle Requirements Studies

This activity was initiated at the completion of the seat/urinal zero-gravity test program to update the design requirements for the prototype system. The objective of the task was to incorporate the results of the zero-gravity test

program and to incorporate any requirements thought necessary by Rockwell International Corporation, the prime Space Shuttle contractor. Several minor changes resulted from this activity, primarily in the capacity requirements of the system for waste product storage.

There were two changes in the design requirements that had major impact on the design when compared to the development unit. The first change was the elimination of the requirement to interface with an anal wash kit. This change affected the upper portion of the collector making it simpler and smaller.

The second change was the elimination of the requirement to not allow intimate urinal contact. Discussions with the NASA led to a requirement to make the urinal as earthlike as possible, while limiting the urinal airflow to a maximum of 1.18×10^{-2} m^3/s (25 scfm) at 1.34×10^5 N/m^2 (14.7 psia) and 294.4°K (70°F). The result of this activity was a subsystem requirements specification for the Preliminary Flight Prototype Waste Collection Subsystem, which is included as Appendix B of this report.

Subsystem Design

The Waste Collection Subsystem Preliminary Flight Prototype Unit was designed with a degree of sophistication that allowed maximum use of commercial grade hardware, thereby minimizing cost while still producing a representative configuration flight prototype unit that met all program objectives. The first task in the design phase was the selection of a new urinal configuration based on zero-gravity test results and subjective evaluation. Another early task was to improve wipe retention capability of the commode. Once these concepts were established, the overall system was evolved. Further design effort was expended to identify all nonmetallics contained in the flight prototype WCS and to define the hardware necessary to interface the WCS with the Representative Shuttle Environmental Control System (RSECS) being procured by NASA under contract NAS 9-13307.

Urinal Concept Selection

Once the decision had been made to eliminate the requirement for an earthlike non-intimate contact urinal, a major effort was initiated to establish a new urinal configuration. Several different concepts for a minimum flow urinal were synthesized and a concept review was held to determine the most promising configuration for a feasibility evaluation. The concept selected was similar in configuration to the two position urinal concept evaluated in the WCS Development Program, contract NAS 9-12150. The size of the urinal opening was set at 7.62 by 8.89×10^{-2} m (3.0 by 3.5 inches). Based on the zero-gravity tests of the SVSK 83745 urinal, it was determined that an airflow of 7.08×10^{-3} m^3/s (15 scfm) would be required to successfully

collect urine from females with the new configuration. The use of urinal backflow air was continued, utilizing 2.36×10^{-3} m^3/s (5 scfm), and the primary flow drawn down between the user's thighs was established at 4.72×10^{-3} m^3/s (10 scfm). The configuration selected still did not require intimate contact with the user; for female use the collector was designed to be brought to a position within one-half inch of the vulva area; male usage was at a different position and would be similar to using an Apollo type urinal.

A feasibility test unit was manufactured and installed on the zero-gravity test fixture for evaluation. Five female and eight male test volunteers participated in the feasibility test program. The urinal was mounted to provide infinite variation in position. Positioning-jets were used by all test volunteers to initially establish their position.

The feasibility test series had four major objectives:

- Reconfirm the back edge position of the urinal needed during female micturition to insure collection of at least 90 percent of the urine in the urinal and no more than 10 percent in the commode. A similar test to establish this position had been conducted in April of 1971 under contract NAS 9-12150.
- Establish the front edge position to collect 100 percent of the female urination. This, in combination with the back-edge criterion above, establishes the urinal size.
- Establish the urinal contour with respect to the female body. This is required to provide controlled airflows into the urinal without requiring intimate body contact.
- Establish the position of the urinal for male collection.

The first test conducted was to establish the back position of the urinal. This test also served as an orientation and familiarization period for the female test volunteers. Data sheets were used to record all subject comments. A sample data sheet is included as Appendix C of this report. The following results were obtained:

- The positioning-jets were considered necessary to insure proper body position.
- The females appeared to achieve more consistent urine stream direction and control if their knees were spread greater than 10.16×10^{-2} m (4.0 in.). This simple adjustment greatly improved the results from two volunteers who had inconsistent stream directions.
- Poor stream direction occurred almost exclusively at the beginning and end of the micturition. At the beginning it probably was due to the dermal adhesion of the labial folds and at the end due to low bladder pressure.

It was concluded that the back edge of the urinal could be located 5.08×10^{-2} m (2.0 in.) in front of the center of the feces collection opening. In this position, two of the five female test volunteers had slight spillage over the back edge of the urinal and in both cases the spillage amounted to less than 5 percent of the total micturition.

The next portion of the test determined the location of the front edge of the urinal. This was accomplished by moving the urinal rearward until spillage over the front edge was encountered. The urinal was moved progressively rearward to a position where the front edge was 10.16×10^{-2} m (4.0 in.) from the center of the feces collection opening. In this position no actual spillage was experienced but one subject did report her stream impinged very near the front edge.

It was concluded from these test results that for female collection the front edge of the urinal should be located 12.7×10^{-2} m (5.0 in.) in front of the center of the feces collection opening. This position allows for some positional variations of the body and allows for a broader anthropometric population over that represented by the test subjects.

Another check was conducted with the female test volunteers to establish the proximity of the urinal front and back edges to the body. This location and the center of the urinal are critical in controlling the urinal air entrainment flows. It was established that the anthropometric tolerances of the female body were low enough to allow the use of a fixed front edge contour airflow gap between the user and the urinal. The existing back edge shape and location were confirmed to be adequate.

Table I presents a general summary of the results obtained from the female tests of the urinal configuration.

The last test conducted in the feasibility series was conducted with the male test volunteers. The male volunteers utilized the urinal and were allowed to adjust the variable urinal to a position best suited to themselves according to the following ground rules:

- No contact with the genitals in a free hanging position.
- Urinal angle compatible with a hand held penis urination.
- The head of the penis should penetrate the top plane of the urinal.
- The urinal also should be placed to catch drops off a hand held penis in one-g.

The individual locations of the eight test subjects were checked and an average position was selected. The average position was satisfactory for six subjects. One thought it was 1.27×10^{-2} m (0.5 in.) too close and another 1.27×10^{-2} m (0.5 in.) too far away.

TABLE I SUMMARY OF RESULTS
MINIMUM FLOW URINAL FEASIBILITY TEST

Subject	Urinal Back Edge Location Tests		Urinal Front Edge Location Tests		
	Back Edge: 9.21×10^{-2} m (3.625") From Back of Feces Coll. Opening Sides: 0.32×10^{-2} m (0.125") Lower Than Seat	Back Edge: 10.16×10^{-2} m (4.0") From Back of Feces Coll. Opening Sides: 0.64×10^{-2} m (0.25") Lower Than Seat	Front Edge: 16.51×10^{-2} m (6.5") From Back of Feces Coll. Opening Sides: 0.64×10^{-2} m (0.25") Lower Than Seat	Front Edge: 15.24×10^{-2} m (6.0") From Back of Feces Coll. Opening Sides: 0.64×10^{-2} m (0.25") Lower Than Seat	Front Edge: 17.8×10^{-2} m (7.0") From Back of Feces Coll. Opening Sides: 0.64×10^{-2} m (0.25") Lower Than Seat
No. 1	*1. Excellent; 100% collection. 2. Poor; urinal contact inhibited use with gross spillage. 3. Good; few drops over back edge of urinal at end of urination; urinal moved down but still slight contact. 4. Excellent collection.	1. Excellent collection.	1. Excellent collection.	1. Good; few drops in beginning near front edge of urinal. Body touched back edge. 2. Excellent; 1.27×10^{-2} m (0.5") gap between urinal and vaginal area. Urine almost went over front edge of urinal.	
No. 2	1. Gross spill; not sure of position. 2. Good; just few drops over rear edge of urinal at end; spread legs wide (4 fingers).	1. Fair; medium spill over back and sides of urinal.	1. Good; few drops back edge and sides of urinal.		
No. 3	1. Excellent collection. 2. Excellent collection; spread legs more than usual (3 fingers @ thighs).	1. Excellent collection.	1. Good; few drops off back of urinal.	1. Excellent; 1.27×10^{-2} m (0.5") to 1.91×10^{-2} m (0.75") gap between urinal and vaginal area.	1. Excellent; 2.54×10^{-2} m (1.0") gap to vaginal area.
No. 4	1. Good; few drops at back and sides of urinal at beginning. 2. Excellent collection. 3. Excellent collection.	1. Excellent collection.	1. Poor; gross spill off back of urinal; moved 2.54×10^{-2} m (1.0") in lining up.	1. Excellent collection. 2. Excellent collection; 1.27×10^{-2} m (0.5") gap between urinal and vaginal area.	
No. 5	1. Excellent.	1. Fair; spill in back of urinal; position not sure.	1. Excellent collection.	1. Excellent; 1.27×10^{-2} m (0.5") gap between urinal and vaginal area.	1. Good; few drops on sides; 2.54×10^{-2} m (1.0") gap between urinal and vaginal area.

Note: *Number refers to urination at this test condition; 1 is first urination, 2 is second urination, etc.

As a result of the male tests, the detent position of the urinal for male usage was established with the back edge of the urinal located 15.24×10^{-2} m (6.0 in.) from the center of the feces collection opening, and the urinal tilted at an angle of 0.61 rad. (35°) from the horizontal, placing the urinal back edge 3.81×10^{-2} m (1.5 in.) below the top edge of the seat.

Figure 11 illustrates the configuration of the urinal evolved from the feasibility tests. The urinal has a 7.62×10^{-2} by 8.89×10^{-2} m (3.0 by 3.5 in.) opening and is detented in two positions. The female position has the back edge 5.08×10^{-2} m (2.0 in.) from the center of the feces collection opening and the male detent position is as described above. The urinal moves in a track and is usable in positions between the two detented positions.

The close proximity of the urinal to the feces collection opening does not allow room for a direct rear entrainment flow. It was determined that with the low flow urinal the same results could be obtained by creating an induced flow. The induced flow enters through the side flow slots on each side of the urinal shown in Figure 11 and still creates the air barrier required to prohibit urine from flowing into the perineal area.

Wipe Retention Study

The ground tests conducted on the Development WCS had shown that it was difficult to retain the wipes in an even distribution about the commode. The wipes tended to fall into the bottom of the commode in a loose mass. Several concepts were considered and the most practical method appeared to be a series of spikes located on the wall of the commode to catch and retain the wipes. An SVSK 77489 commode assembly was modified to conduct a feasibility test of the spike idea. The SVSK 77489 commode was modified by the addition of two sets of spikes, located π rad. (180°) apart in the collector. One set of spikes was 6.35×10^{-2} m (2.5 in.) long and the other set was 2.54×10^{-2} m (1.0 in.) long. Six individual spikes were used in each set. The spikes were installed in vertical rows of three spikes each and were installed canted toward the tangent of the spinning tines. The canting minimized shadowing of the wall from the projected matter and also served to retain the paper against the prevailing air currents in the collector. The slinger used in this test was an early configuration using round tines.

A mixture of dog food and peanut butter was used to create simulated feces. 4.08 kg (9.0 lbs) of the mixture in the form of 42 various sized and shaped stools were deposited into the commode. In addition, slightly over a half roll of toilet tissue was deposited. The tissue was deposited in amounts from one sheet to twenty sheets, in both a wet and dry condition.

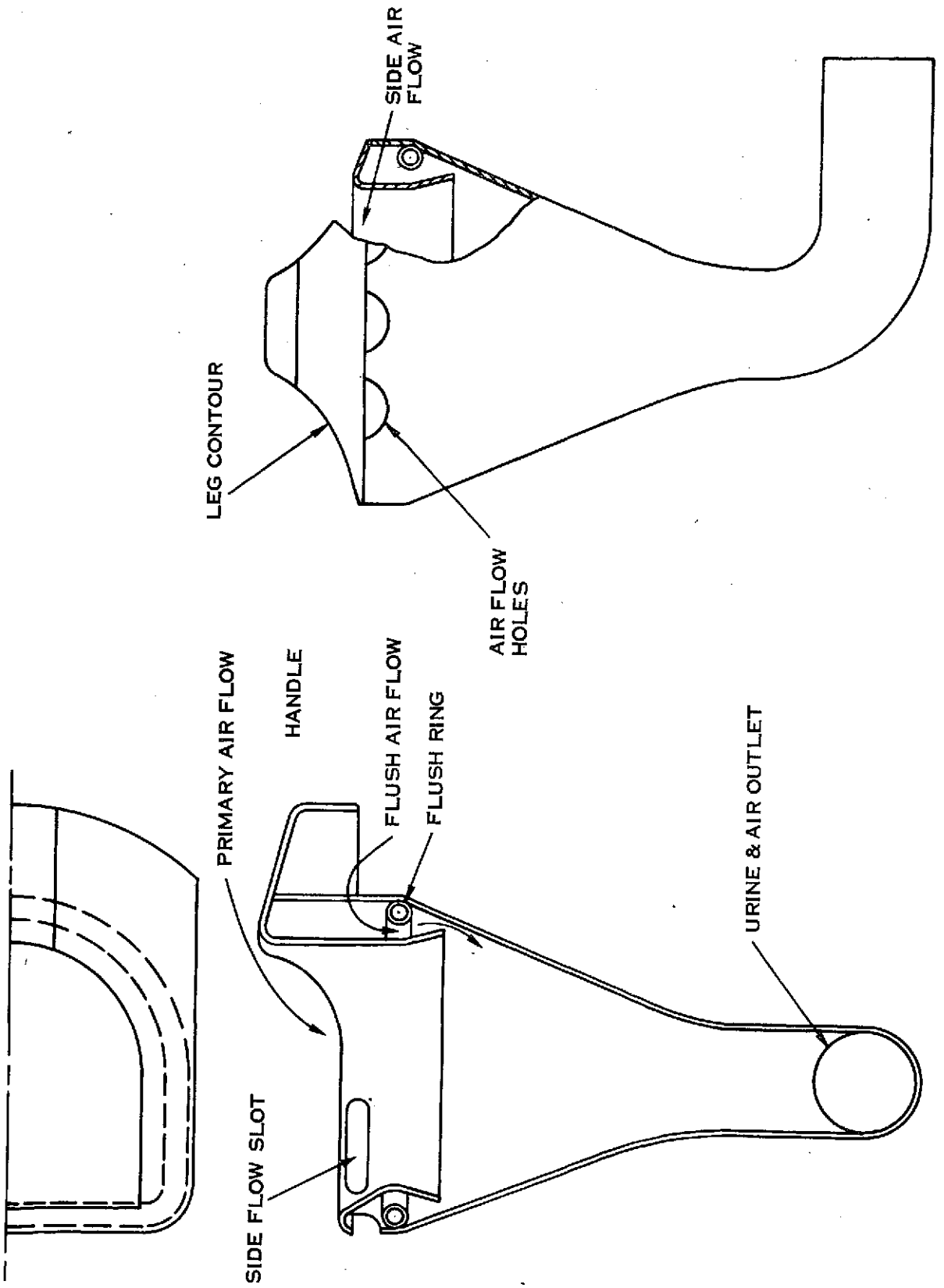

FIGURE 11. MINIMUM FLOW – TWO POSITION URINAL CONFIGURATION

The slinger distributed the simulated feces mixture in a fairly uniform band about the circumference of the collector. Not all of the mixture adhered to the wall. Approximately 10 percent dropped to the trough. The consistency of the matter in the trough varied from totally disintegrated to small pieces.

When dry tissue was deposited into the collector it was found that large amounts did not penetrate the round slinger tines but would be retained in a streamer configuration on the inside of the slinger. Approximately 50 percent of the paper did penetrate on initial deposit or blew through in a loose fashion after a few seconds. These tissues generally would be blown around the periphery of the collector by the slinger generated airflow for one or two revolutions, and then would be captured and retained by the spikes. The tissue that did not come off the slinger by itself would be cleared by a subsequent stool deposit and in many cases the stool embedded the tissue on the wall.

When wet wipes were deposited they were distributed by the slinger and adhered to the wall with the mixture.

The test results indicated that the protruding spikes would be an effective method of capturing and retaining the dry tissue wipes within the commode. The longer spikes 6.35×10^{-2} m (2.5 in.) performed better than the shorter version, especially as the thickness of the collected matter increased. The testing also illustrated again the superior adhesion qualities of wet wipes. A repeat of this test was accomplished using a knife-edge tine configuration, to evaluate the improvement in shredding and clearing of the tissue wipes compared to the round tine configuration. The knife-edge tines were tested with the same simulated feces mixture of dog food and peanut butter as the round tines, and tissue wipes were introduced into the commode in a normal usage manner. The slinger distributed the feces fairly uniformly in a band about the circumference of the collector. The knife edges shredded or tore the paper better than had the round tines. It is estimated that perhaps 20 to 25 percent of the paper was shredded compared to 5 to 10 percent with the round tines. In addition, the knife-edge tines cleared themselves of all tissue wipes, either wet or dry. In some cases the dry tissue would become entwined in the tines and would clear itself within 2 to 3 seconds. As in the round tine test, the tissues that did not shred and become mixed with feces were captured by the retaining spikes.

The feasibility tests conducted with both the round and knife-edge tines proved the effectiveness of the spike retention system for tissue wipe control and it was decided to incorporate a series of long 6.35×10^{-2} m (2.5 in.) spikes with the commode.

System Description

The operational schematic of the Preliminary Flight Prototype Waste Collection Subsystem is presented in figure 12. The subsystem consists of the commode assembly, the support equipment package and the tank package.

Commode Assembly

The commode assembly serves as the waste collector and the feces storage/processing unit. This portion of the assembly consists of the commode seat which is similar to the seat used in the Development WCS. Support for the user is provided at the ischial tuberosities and the seat is contoured to provide buttock spread and load distribution in a one-g environment. The seat interfaces with the fecal transfer duct through the manifold flange, which is essentially a mounting plate. Attached to the manifold flange are the urinal tracks that guide the urinal from the male to the female positions. The tracks are contoured to provide a horizontal opening for female urine collection with the urinal against the feces collection opening. The track provides for motion of the urinal to the detented male position and orients the urinal into a more vertical position for male usage. The track assembly contains detents to hold the urinal in the extreme positions; however, the track and rollers on the urinal allow the urinal to be placed and remain in any position between the detents.

The manifold flange also has attached to it mounting points for a seat belt and hand holds, both of which are needed to assist the user in maintaining position in the zero-gravity environment.

The urinal, illustrated in figure 11, which is part of the commode assembly, is attached via the track by four rollers, which are mounted on bosses molded into the fiberglass body of the urinal. The urinal body was designed to include all the required openings and contours necessary to guide the entrainment airflow for successful urine collection and control of the urinal flush water. Also formed into the urinal body is a handle to assist in moving the urinal and a leg contour guide for the user. The urinal incorporates an integral flush ring that connects to a water supply line from the support equipment package. The urinal outlet also connects via a duct to the support equipment package. The urinal has a cover that is utilized during the urinal flush and when the urinal is not being used.

The manifold flange is connected to the fecal transfer duct. The fecal transfer duct contains provisions for entrainment airflow for separating and moving the stool from the anus to the storage/processing section. In addition, the transfer duct also contains the positioning air-jet nozzles that assist the user in positioning properly on the seat.

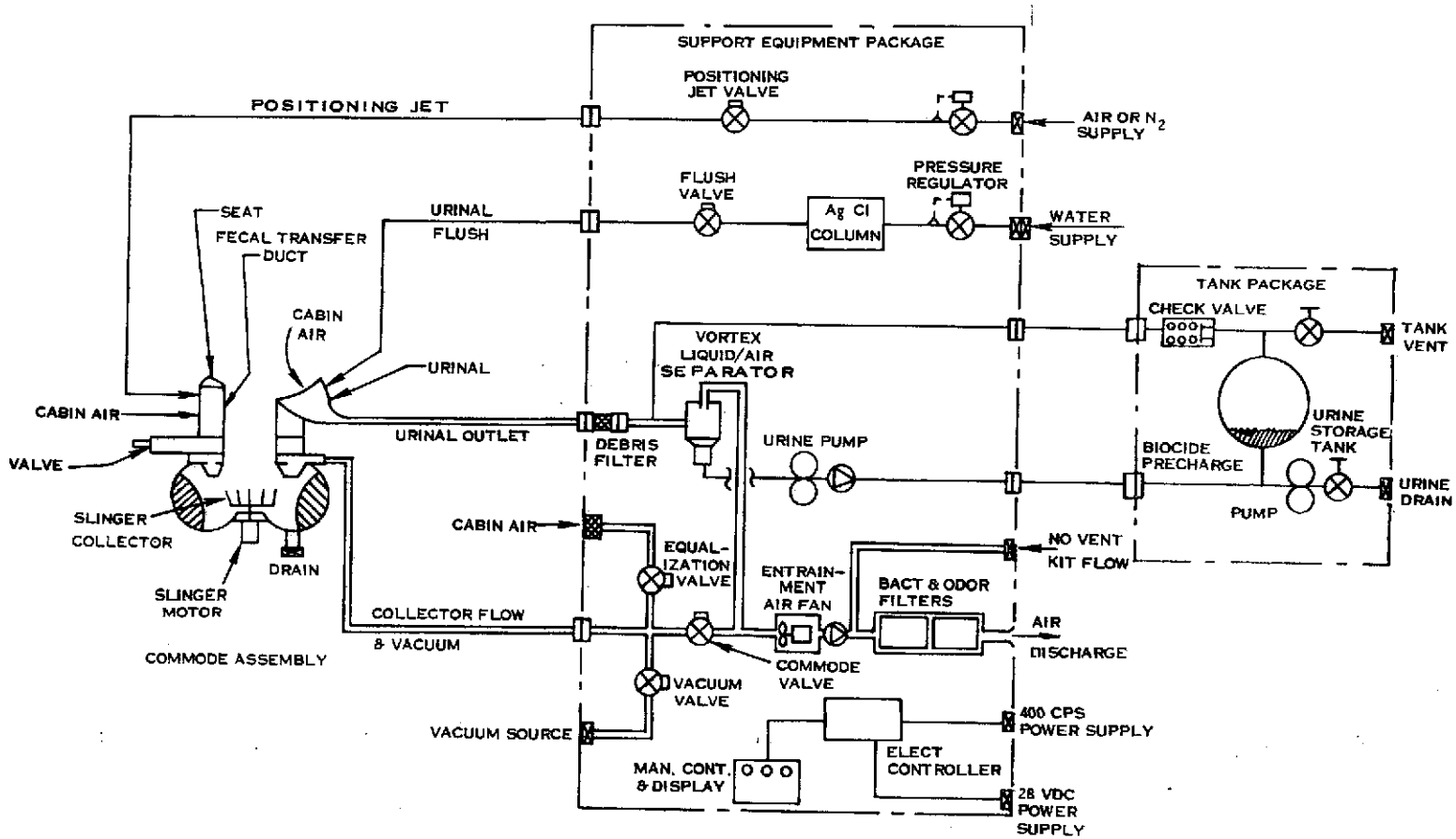

FIGURE 12 PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM SCHEMATIC

The interface between the transfer duct and the feces storage/processor is the collector valve. This valve is a manually actuated gate valve and is an important design feature of the commode assembly. When closed, it seals the storage/processor to permit vacuum drying of the feces, and in its open position allows the proper transfer of solid wastes through it. The valve design utilizes a gate, without using the normal shear-type seals that are inherently poor vacuum seals. An actuation scheme, which lifts and rotates the gate, is used instead.

The feces storage/processing unit is an oblate spheroid modified to allow integration of a slinger and air-flow ducts. This configuration allows maximum storage within the distributional limits of the slinger for minimum collector weight. The unit has a minimum storage capacity of 120 man-days of feces and cleansing wipes. The outlet airflow manifold achieves the desired flow patterns in the collector and has a large filter area to minimize the possibility of clogging. The slinger and air inlet and air outlet duct locations are positioned so that airflow must pass through the slinger tines. This arrangement subjects all the deposited feces and wipes to the shredding and slinging action. The slinger relies on a knife-edge tine design to shred and distribute the feces, wipes, and other wastes which may be deposited in the commode. The slinger motor is mounted externally on the feces storage/processor, permitting efficient air cooling of the motor and ease of motor maintenance.

Tests conducted during the WCS Development Program, NAS 9-12150, indicated that packing and distribution of a large number of cleansing wipes was less than optimum. The wipes tended to bunch up and fall in the lower trough of the collector. Consequently the Preliminary Flight Prototype WCS commode incorporates a series of 36 retention spikes spaced within the circumference of the commode to capture and retain any loose wipes. In addition to the wipe retention devices the commode incorporates a drain to facilitate cleaning of the commode. Figure 13 depicts a view of the commode assembly components.

Support Equipment Package

The support equipment package contains all equipment necessary to operate the WCS and to interface the system to the facility/vehicle. The support equipment package, including the controls, is located next to the commode assembly to allow convenient operation by the commode user. The majority of the components in the package are commercial equipment; however, they have been carefully chosen for low weight and volume so that they are representative of flight weight and volume. Their supporting structure, however, is designed to facilitate ground and zero-gravity aircraft testing and structural requirements. The support equipment package contains five major sections:

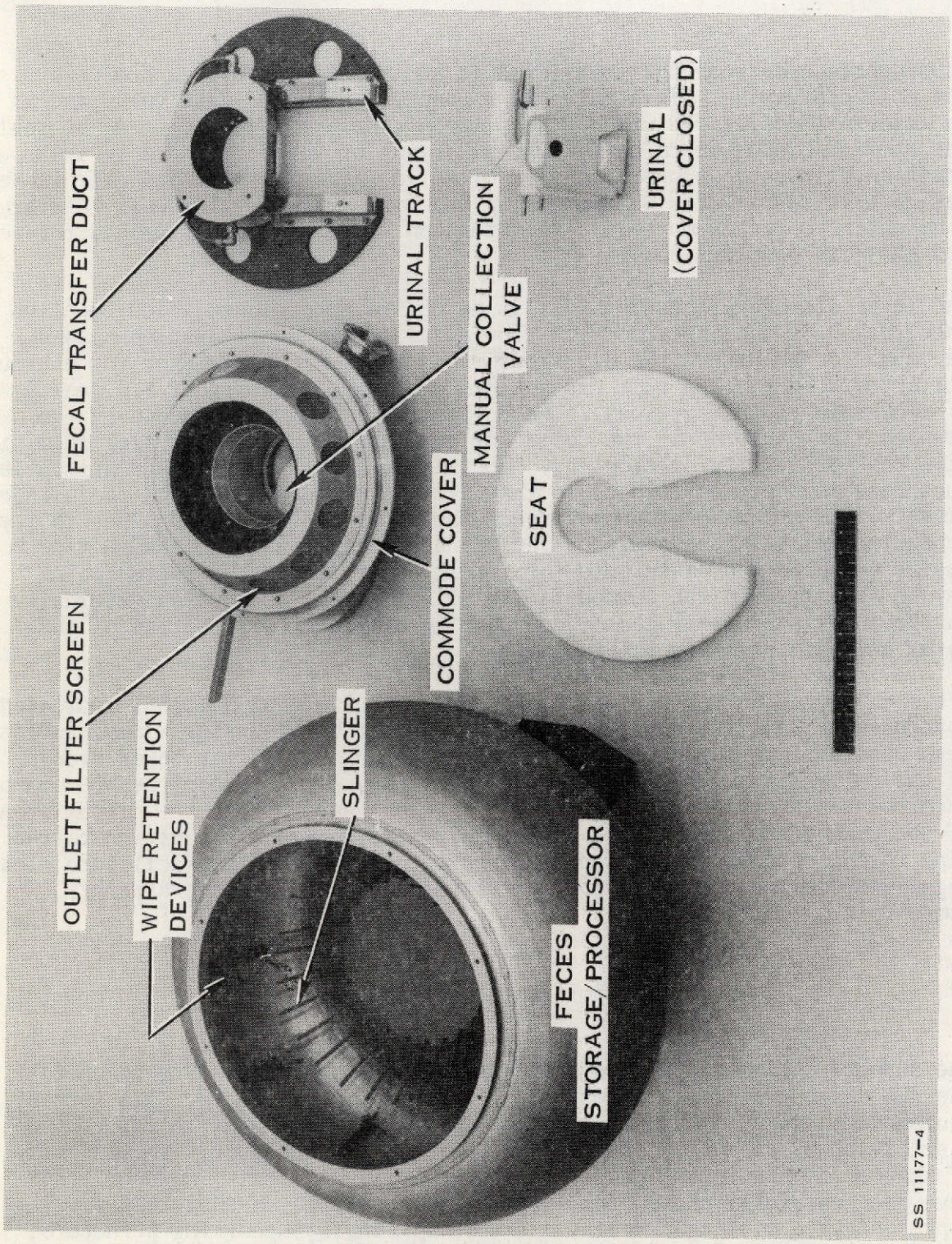

FIGURE 13. COMMODE ASSEMBLY COMPONENT BREAKDOWN

User Positioning-Jet Section.- The user positioning-jet system utilizes a solenoid-operated valve controlled by the user via a switch on the control box. A manually adjustable pressure regulator is placed upstream of the solenoid valve to control the pressure of incoming gas, either air or nitrogen. The solenoid valve controls the flow of gas to the positioning juets located in the transfer duct of the commode assembly.

Urinal Flush/Bactericide Section.- The urinal flush system utilizes an external water supply for flushing. Water enters the unit through a manually adjustable pressure regulator controlled at 3.08×10^5 N/m^2 (30 psig). The urinal flush water then passes through a passive device containing silver chloride, that was developed by Chemtric, Incorporated under contract NAS 9-12104, Potable Water Bactericide Agent Development. Downstream of the silver chloride container is a solenoid valve that controls the amount of flush flow to the urinal. The solenoid valve is controlled by a manually adjustable, timed relay in the controller. Testing revealed that 9.1×10^{-2} kg (0.2 lbs) of water provides an effective flush for the urinal; to provide this flush the valve is opened for 4.5 seconds.

Urine Transfer and Separation Section.- The urine transfer and separation section consists of a fan that provides the required urine entrainment airflow, a vortex liquid/air separator, a pump and an appropriately placed debris filter. The liquid/air mixture is drawn out of the urinal by the 7.08×10^{-3} m^3/s (15 scfm) entrainment airflow provided by the fan. The same fan also provides the feces entrainment airflow. The liquid/air mixture passes through a debris filter, which is a removable wire screen filter, and then enters the vortex liquid/air separator. The vortex separator was redesigned to accommodate the changes recommended as a result of the urinal/seat zero-gravity tests and the reduced 7.08×10^{-3} m^3/s (15 scfm) airflow. Once the liquid has been separated from the air it is pumped from the separator sump through a check valve to the collection tank in the tank package. The separated air is drawn through the fan and through the bacteria and odor removal filters and exited into the test area. The bacteria filter is a Flanders-type absolute air filter, and the odor removal filter is a canister packed with "Purafil" and charcoal. The filters are similar to those designed for the Space Station Prototype program (NASA JSC contract NAS 9-10273) and those being used in the Representative Shuttle Environmental Control System (RSECS) program (NASA JSC contract NAS 9-13307). Purafil is a solid odoroxidant manufactured by Marbor Chemical Division of Borg-Warner Corporation. The basic material is activated alumina (Al_2O_3) impregnated with potassium permangante ($KMnO_2$). The charcoal contained in the filter is a type AC activated charcoal, manufactured by Barnaby-Cheney, Incorporated.

Feces Transfer and Vacuum Drying Section.- The transfer of feces from the user into the storage/processor portion of the commode is accomplished by air entrainment. The required airflow of 9.44×10^{-3} m^3/s (20 scfm) is provided by the same

fan that provides the urine entrainment airflow. The feces entrainment air is directed from the commode through the previously mentioned bacteria and odor removal filters and into the cabin. Three solenoid valves are used to control the airflow in the commode and the vacuum drying process for the commode. One valve controls exposure to vacuum, the second valve is used to equalize pressure in the commode, and the third valve allows the entrainment flow to be directed through the filters and into the cabin. Also provided upstream of the filter package is an inlet port to allow exhaust gas from a no-vent kit to pass through the bacteria and odor control filters.

Control Section.- The controls to operate the WCS also are contained in the support equipment package. The control system is split into two portions, the electronic controller and the manual control and display box. The electronic controller contains the required timers and relays to allow operation of the system. In addition, the controller provides power outputs to operate the slinger in the commode assembly and the pump in the tank package. The manual control and display box is attached to the controller by a cable that allows the box to be remote from the support equipment package or remain mounted on the package. The box contains three switches for operating the WCS: a "system on" switch, a "positioning-jet activation" switch and a "system shutdown" switch. All sequencing of the valves and operation of components are done in the electronic controller. In addition, three indicator lights are provided on the panel, a red light indicating vacuum is present in the commode, a green light indicating the system is ready for operation and a white light indicating the system is in the shutdown cycle. The prototype WCS operates on 115 V, 3 phase, 400 Hertz and 28 Vdc power.

Tank Package

A tank package is provided with the prototype WCS to facilitate ground and zero-gravity testing. The package is not representative of a flight vehicle waste liquid collection system. The storage tank is stainless steel with a 0.152 m^3 (40 gal) capacity. A pump and valves to allow draining of the tank are provided. In addition, the tank is vented back to the liquid/air separator, for zero-gravity operation when tank pressure relief is required.

Figures 14 and 15 depict the complete Preliminary Flight Prototype Waste Collection Subsystem.

Non-Metallic Materials Identification

An effort was initiated after the Preliminary Flight Prototype WCS was designed and in functional test to identify all non-metallic materials contained within the WCS. This effort was made necessary as a result of

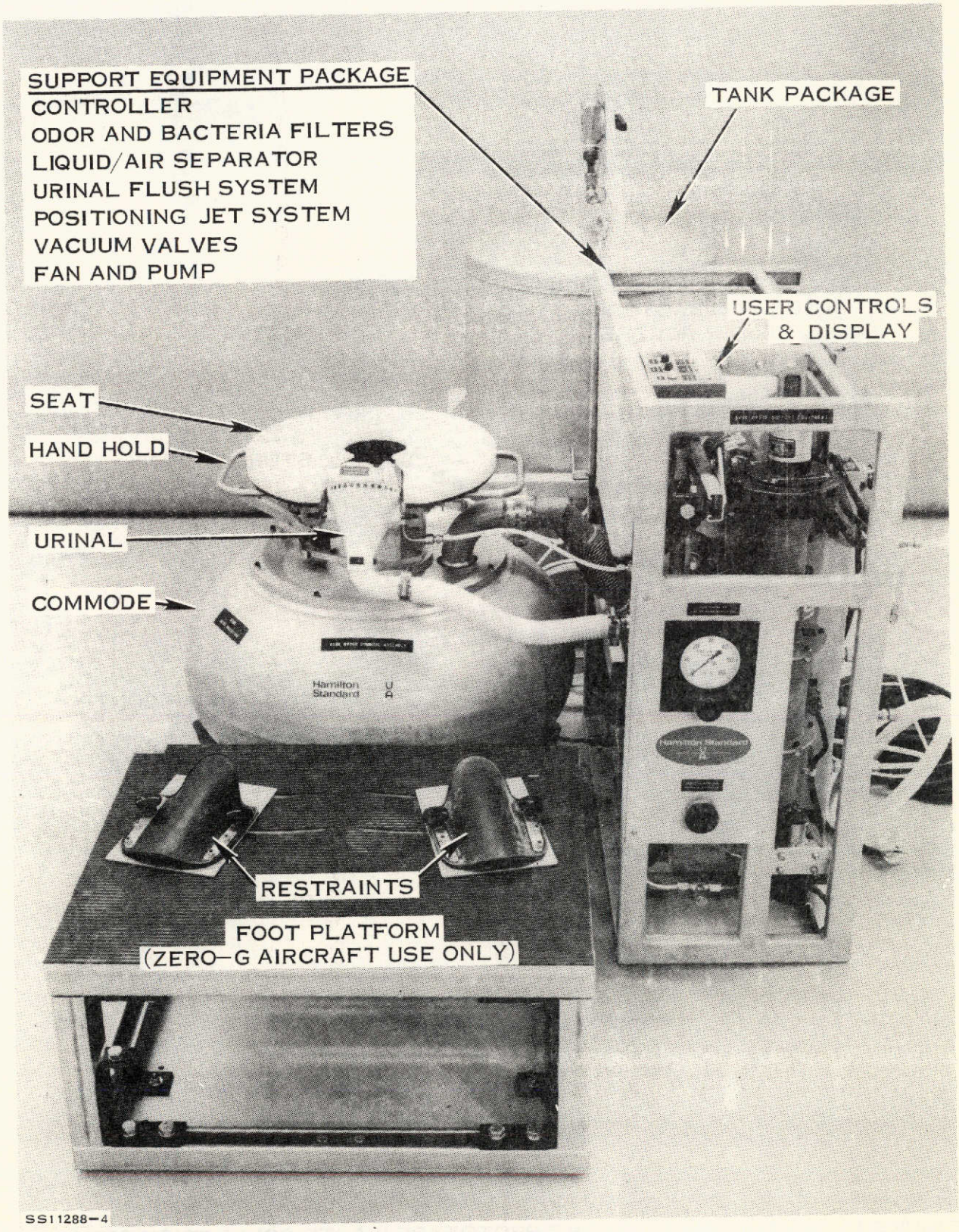

FIGURE 14. PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM—FRONT VIEW

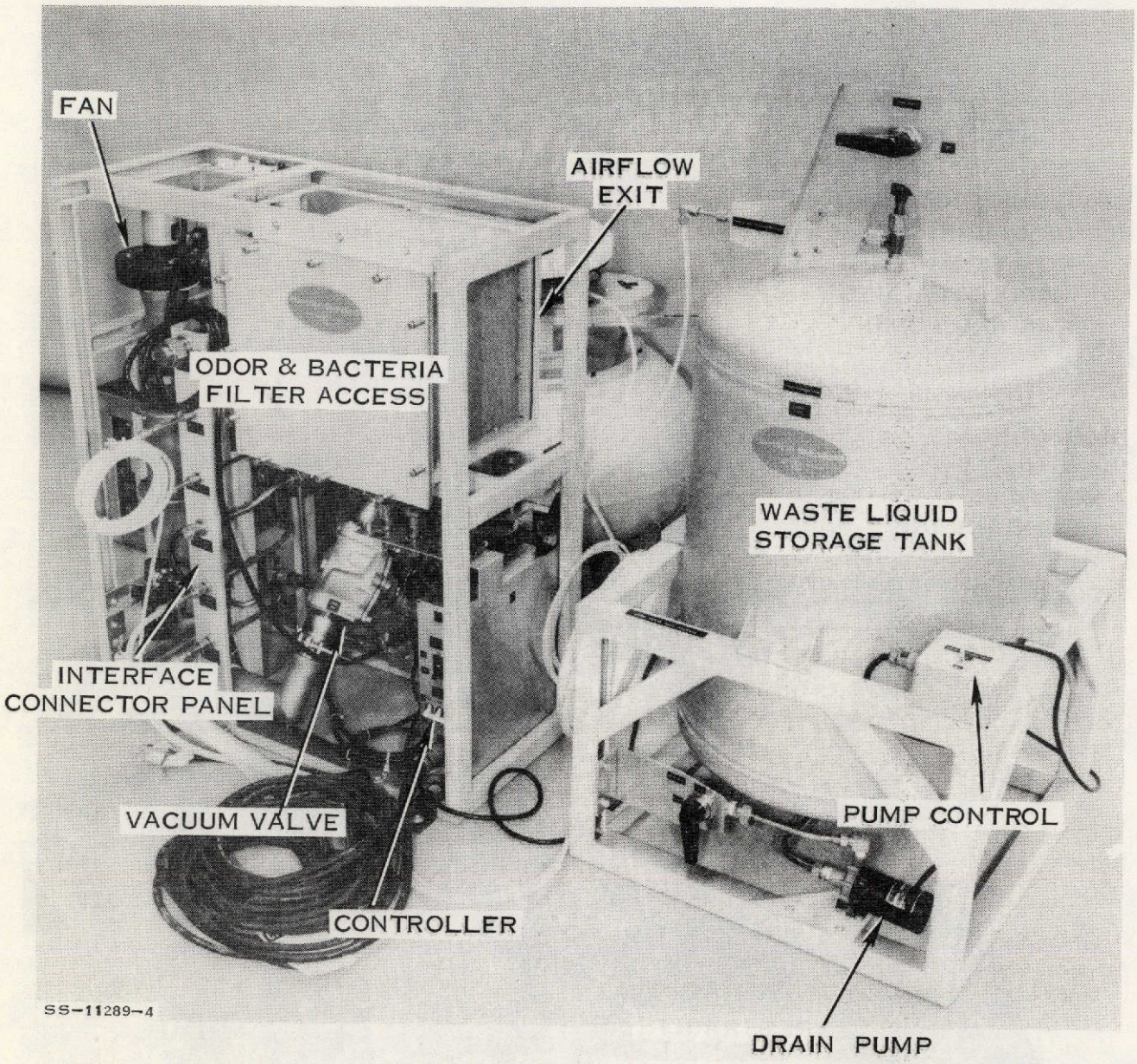

FIGURE 15. PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM – REAR VIEW

NASA's decision to integrate the Preliminary Flight Prototype WCS with the RSECS for chamber testing at NASA JSC. The task consisted of identifying all non-metallics contained within the WCS and calculating or estimating the weights and areas of the non-metallics contained. In the case of vendor designed components, either Hamilton Standard provided the information or the vendor was contacted to provide the information. All components and assemblies, with the exception of the motors in the liquid pumps, had their non-metallics identified. The required motor information was not available to Hamilton Standard or to the pump supplier. Appendix D of this report contains copies of the non-metallics material lists resulting from this activity.

WCS/RSECS Integration

The WCS/RSECS integration task was initiated at the same time as the non-metallic material effort. After several interface discussions with the NASA, it was decided to integrate only the urine collection, transfer and separation functions with the RSECS. This task then involved design and fabrication in three areas. A line was fabricated to go from the urinal exit on the commode to the inlet of the RSECS rotary liquid/air separator package. It was determined that due to the flow characteristics of the rotary separators the maximum length of the line could be 1.22 m (4 ft). With the urinal disconnected from the support equipment package it is then necessary to provide an orifice plate to go over the entrance to the vortex liquid/air separator, to maintain proper airflow split and provide the necessary feces collection entrainment airflow.

A third change to the WCS required modification of the electronic controller. A relay and a connector were added to interface the WCS controller with the RSECS controller. With the two controllers connected, initiation of the "system on" sequence in the WCS also turns on the rotary liquid/air separators in the RSECS.

This arrangement allows the WCS to be operated in its normal mode or with the RSECS, with a minimum of hardware impact or changeover effort.

PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM ACCEPTANCE TEST

The acceptance test on the Prototype Waste Collection Subsystem consisted of a functional checkout and then a 42 man-day usage test. The test results are discussed in this section. All subjective comments were recorded on test summary data sheets. A sample data sheet is included as Appendix E of this report.

Functional Tests

The Preliminary Flight Prototype Waste Collection Subsystem was installed in a lavatory adjacent to the office area of the Space Systems Department for the convenience of the test volunteers. Figure 16 depicts the system as installed.

The system was set up for operation and was found remarkably free of problems. One solenoid valve was operating improperly and it was found that the valve manufacturer had reversed the installation from the markings on the valve body.

The urinal flush was established. It was found that a 3.08×10^5 N/m^2 (30 psig) water pressure gave an effective flush that lasts for 4.5 seconds and utilizes 0.09 kg (0.20 lbs) of water. The system start-up time from initiation of the start cycle is 15 seconds. This compares with close to 70 seconds for the Development WCS and provides corrective action for the subjective comments recorded during the Development WCS test program, relative to the long start-up time. The positioning-jet pressure was set at 3.08×10^5 N/m^2 (30 psig). In addition, the urine storage tank was precharged with one gram of silver nitrate mixed with 227 grams of water. The silver nitrate is utilized as a bactericide to inactivate the urine in the storage tank. At the conclusion of this activity the system was prepared for the acceptance test.

Acceptance Test

The statement of work for the Preliminary Flight Prototype Waste Collection Subsystem specifies a 42 man-day "hands-off" acceptance test of the system was to be performed, utilizing both male and female subjects. In the course of setting up for the test program, five male and three females volunteered to utilize the system. All the test volunteers were accepted, the extra volunteers providing for contingencies.

The test volunteers utilized the system for a total of 60 man-days. During the test period the unit was utilized for 41 defecation/urinations and for 36 urinations. A total of 690 tissue wipes was deposited into the commode.

The WCS operated almost trouble-free during the test period. Two equipment problems were discovered during the course of the tests. The check valve downstream of the urine pump stuck in a closed position; however, one of the test volunteers noted a strange sound in the pump and the valve was cleaned before any urine backup was experienced in the system. The cause of the check valve sticking was some type of oily film which apparently was left in the valve from the manufacturing process. Once the valve was cleaned there was no recurrence of the anomaly.

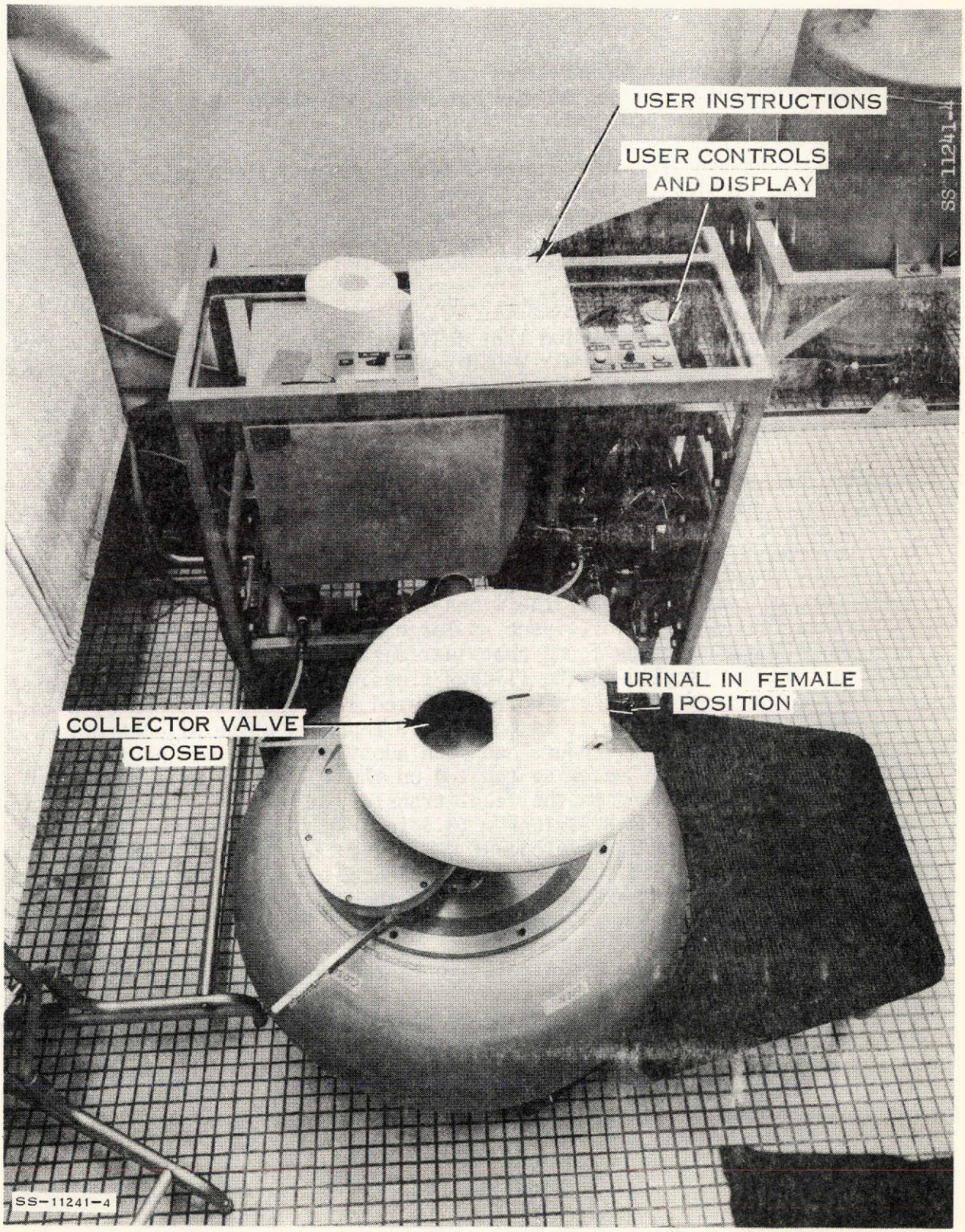

FIGURE 16. PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM ACCEPTANCE TEST INSTALLATION

The second problem was the presence of a strong fecal odor in the test area. It took four days to trace the problem during which the test subjects made many complaints about the bad smell in the test area. Initially it was thought that the odor filter was not effective even though testing in the past had indicated that the "Purafil"/charcoal filter was an effective odor control device. The problem finally was traced to inadequate baffling and sealing within the filter plenum assembly, allowing air to bypass the odor filter and exit directly into the test area. The problem was temporarily solved by taping the outside of the plenum assembly.

During the refurbishment period that followed the testing the plenum assembly was reworked to insure that air would pass through the filters. The rework consisted of installing a channel section between the bacteria and odor filter to tighten the general fit and installing silicone rubber gaskets around the filters to seal the side areas.

Standard household toilet tissue was used during the test program with a total of 690 wipes deposited into the commode. The standard tissue represented a more conservative test for the commode, particularly in checking out the commode's wipe retention capability, because the standard tissue bulk is greater than that of controlled wet and dry wipes. Initially the test volunteers were allowed to deposit the wipes in any manner they desired. The result was that sections of tissue as large as twenty sheets were thrown into the slinger. It was found that sections of that size tended to get wound around and tangled on the slinger tines. After the first three days of testing the test volunteers were requested to deposit sections of wipes no larger than three wipes, this being more representative of controlled wipe usage. Once this procedure had been adopted, there were no further problems with the wipes becoming tangled on the slinger. There were only five instances of soiling on the fecal transfer duct during this test series, which indicates that the 8.89×10^{-2} m (3.5 in.) shortening of the duct from the configuration used during Development WCS tests had a significant beneficial effort. The cases where soiling was experienced generally occurred when the test volunteer did not make careful use of the positioning-jet, or when the bowel movement was extremely loose.

The only other comment received relative to the system performance was that two of the male test volunteers thought the detented male position of the urinal could be 1.91×10^{-2} to 2.54×10^{-2} m (0.75 to 1.0 in.) closer to the user. The subjective comments recorded during the test program are contained in Table II. It should be noted that only specific comments are tabulated. Instances when the volunteers utilized the system and only recorded the use or checked that everything operated properly are not recorded.

TABLE II 42-MAN DAY ACCEPTANCE TEST SUBJECTIVE COMMENTS

Comment Number	Test Day	Test Subject	Comment
1	1	Male A	Positioning-jet effective with fecal collection airflow; shook one drop to back edge of urinal.
2	1	Male B	Could be smaller positioning jet, to let more accurate positioning.
3	1	Male C	Had to move around to locate anus.
4	1	Male A	Urinal flushed all urine drops off wall.
5	1	Female A	Everything OK. Urinal 1.27×10^{-2} m (0.50 in.) from body.
6	2	Female B	Urinal 1.27×10^{-2} m (0.50 in.) from body.
7	2	Female C	Thighs closed at front edge of urinal - OK.
8	2	Male B	Slinger had paper caught on it (see Note A).
9	2	Male A	Slinger clogged with paper - bolus got caught in paper causing vibration. After bolus went through vibration stopped (see Note A).

TABLE II 42-MAN DAY ACCEPTANCE TEST SUBJECTIVE COMMENTS (CONT'D)

Comment Number	Test Day	Test Subject	Comment
10	2	Male B	Small fecal smear approximately 0.40×10^{-4} m^2 (0.06 in^2) in size.
11	2	Male D	Noted some smell in room and when system was operating (see Note B).
12	2	Male B	Pump making noise (see Note C).
13	3	Male E	Would like urinal slightly closer in.
14	3	Male B	Would like urinal 1.91×10^{-2} m (0.75 in.) from full forward position.
15	3	Male A	Slinger had paper trapped in tines.
16	3	Male A	Urinal 1.91x10-2 m (0.75 in.) back - slinger had paper and unit vibrated.
17	3	Male D	Tried closer urinal position - it was acceptable.

TABLE II 42-MAN DAY ACCEPTANCE TEST SUBJECTIVE COMMENTS (CONT'D)

Comment Number	Test Day	Test Subject	Comment
18	6	Male B	Soiled transfer duct $3.81 \times 0.64 \times 10^{-2}$ m (1.50x0.25 in.) on back wall - I should have been sitting more forward and checked with jets.
19	6	Male A	Smells better.
20	6	Male B	Soiled back of duck $3.18 \times 0.64 \times 10^{-2}$ m (1.25x0.25 in.), slightly loose bowels today.
21	6	Male B	Hit back of duct again.
22	6	Male B	Brought urinal in approximately 2.54×10^{-2} m (1.0 in.).

TABLE II 42-MAN DAY ACCEPTANCE TEST SUBJECTIVE COMMENTS (CONCLUDED)

Comment Number	Test Day	Test Subject	Comment
23	7	Male A	No perceivable odor today.
24	7	Male B	Hit back of transfer duct again.
25	9	Female B	Decided I have to sit further forward to avoid soiling back of transfer duct.

Notes: General - This table contains specific subjective comments; uses of the WCS in which the volunteers had no specific comments other than "operation normal" are not included.

A. This was during uncontrolled wipe portion of test; see discussion in text.

B. Smell was due to bypassing of filter; see discussion in text.

C. Noise caused by pump working against jammed check valve; valve fixed and everything OK.

In general, except for the anomalies mentioned, the system operated as designed throughout the test program. The urine/flush water storage tank was utilized for waste liquid collection during the test program and was drained at the conclusion of testing. The precharge of silver nitrate placed into the tank prior to the start of testing appeared to be an effective bactericide. During the course of the testing no odor was noted coming from the storage tank although the tank was allowed to vent into the test area.

Commode Inspection and Cleaning

At the completion of the test program the commode was opened and the feces and wipe distribution checked. There was a very uniform distribution of feces and wipes within the commode. The commode was approximately fifty percent filled with feces and wipes and the occupied volume was approximately ninety percent wipes. The wipe retention devices had been very effective in capturing and retaining the wipes in a uniform distribution about the circumference and sides of the commode. Figure 17 is a photograph taken looking down into the commode and shows the even distribution of the feces/wipes mixture throughout the commode. Figure 18 is a photograph taken from the side and shows the even distribution up to the top of the collector.

Comparison of these photographs with those taken after the Development Waste Collection Subsystem tests as reported in NASA CR 133977 (contract NAS 9-12150) readily reveals the effectiveness of the wipe retention devices. In the development test unit the wipes all had slipped to the bottom of the collector and the wall was quite bare.

Inspection of the unit found the slinger and air screen area to be quite clean. Figure 17 shows the slinger while figure 19 depicts the air-outlet screen. Figure 19 also shows the soiling in the inlet diffusion section of the commode. The cleanliness of the screen indicates that the slinger efficiently dispersed the feces and wipes and that the mixture adhered to the walls and wipe retention devices, otherwise evidence of feces and wipes would have been on the air-outlet screen.

At the completion of the inspection the commode was moved to the cleaning area. An attempt was made to simulate an in-place cleaning. The commode was filled with water and the slinger activated to agitate the mixture. It was found that the 115 volt motor did not have sufficient torque to bring the slinger up to a reasonable speed (the new 115 V, 3 phase, 400 Hz motor that was installed prior to the start of zero-gravity tests has triple the torque capability and will be adequate to agitate the mixture), consequently the motion had little effect. The drain on the bottom of the commode was opened and the mixture emptied. This procedure was followed three times and approximately 95 percent of the contents were flushed out of the commode. At this point a hose nozzle was used to get the remaining five percent of

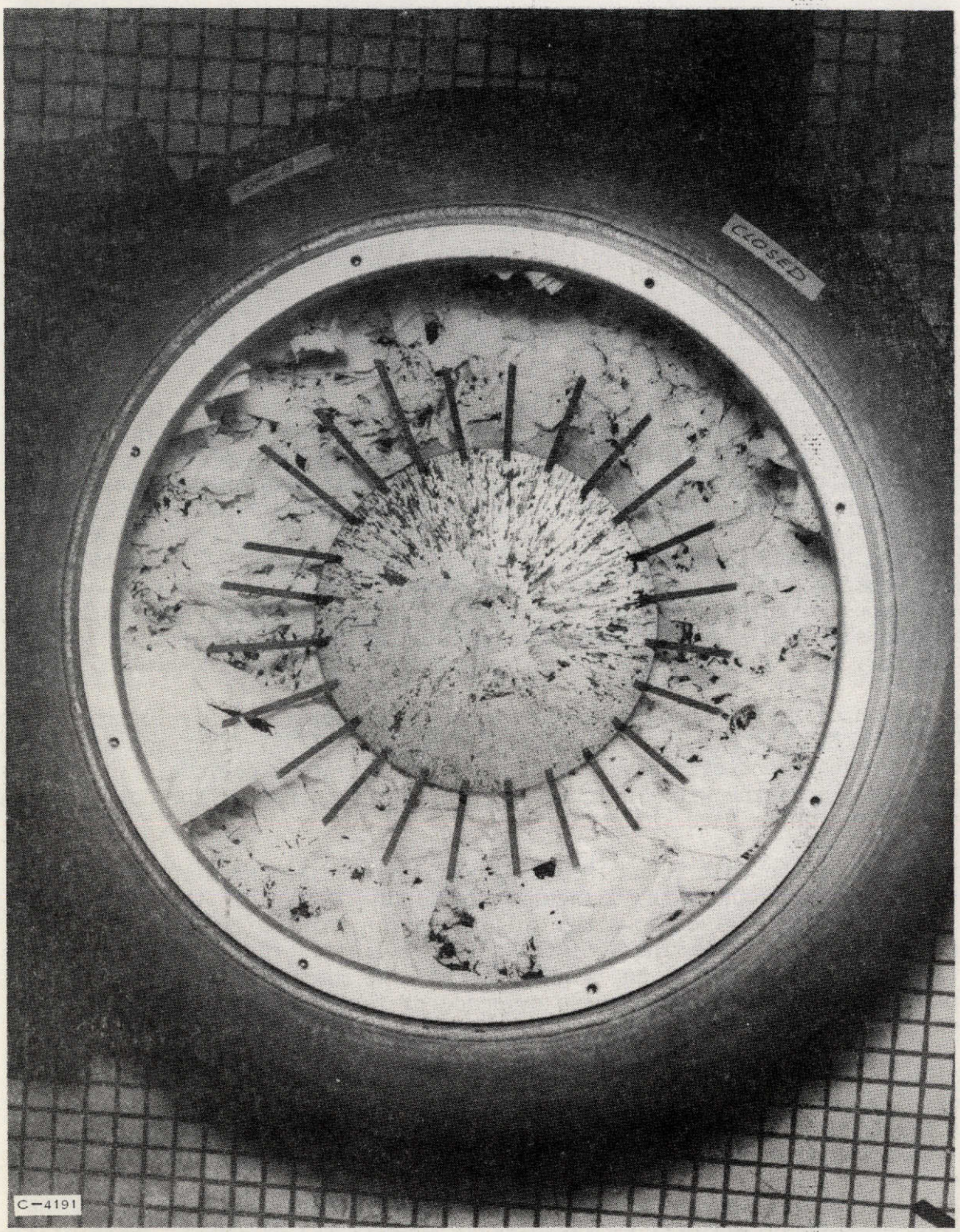

FIGURE 17. FECES AND WIPE DISTRIBUTION IN COMMODE AFTER 42 MAN-DAY ACCEPTANCE TEST (TOP VIEW)

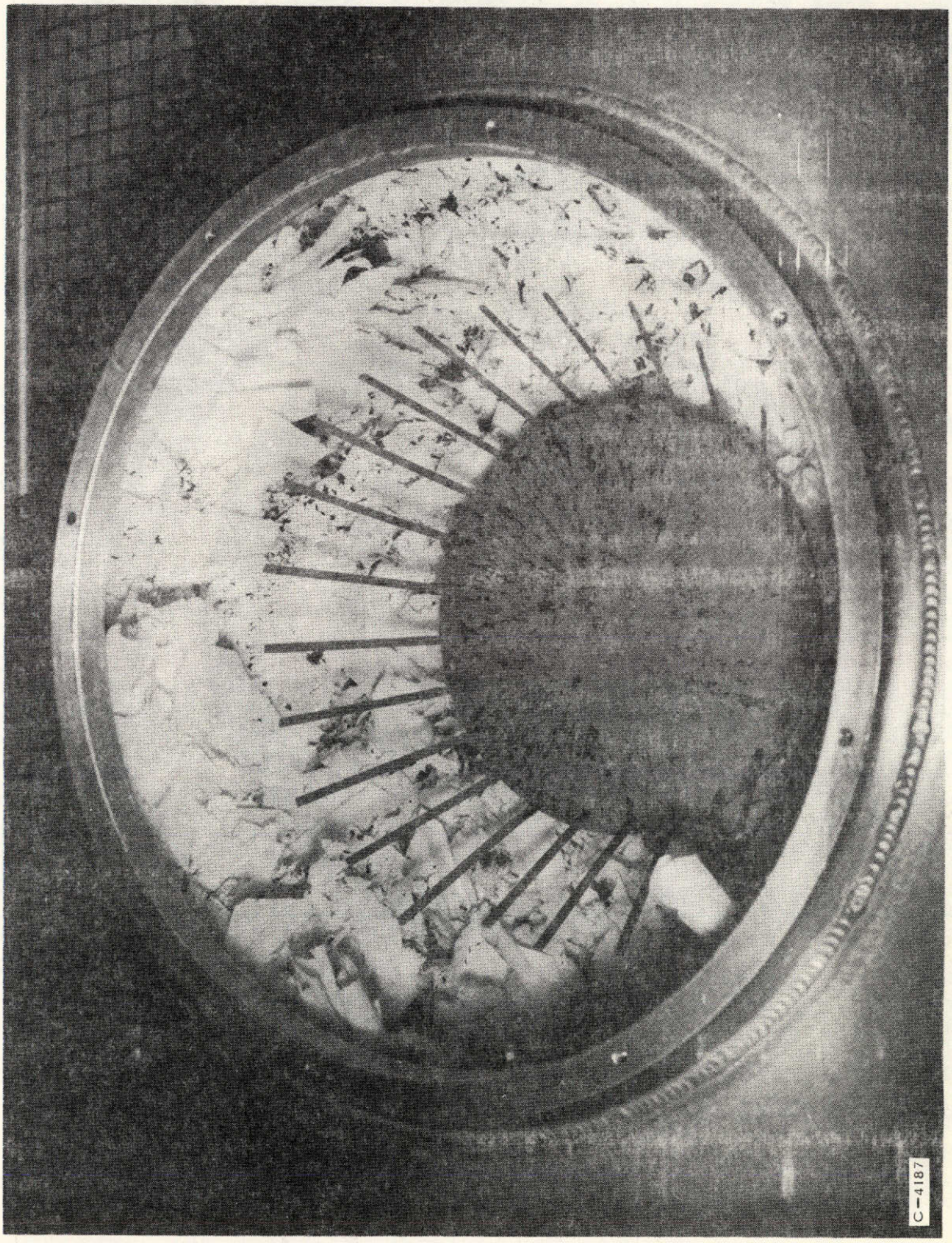

FIGURE 18. FECES AND WIPE DISTRIBUTION IN COMMODE AFTER 42 MAN-DAY ACCEPTANCE TEST (SIDE VIEW)

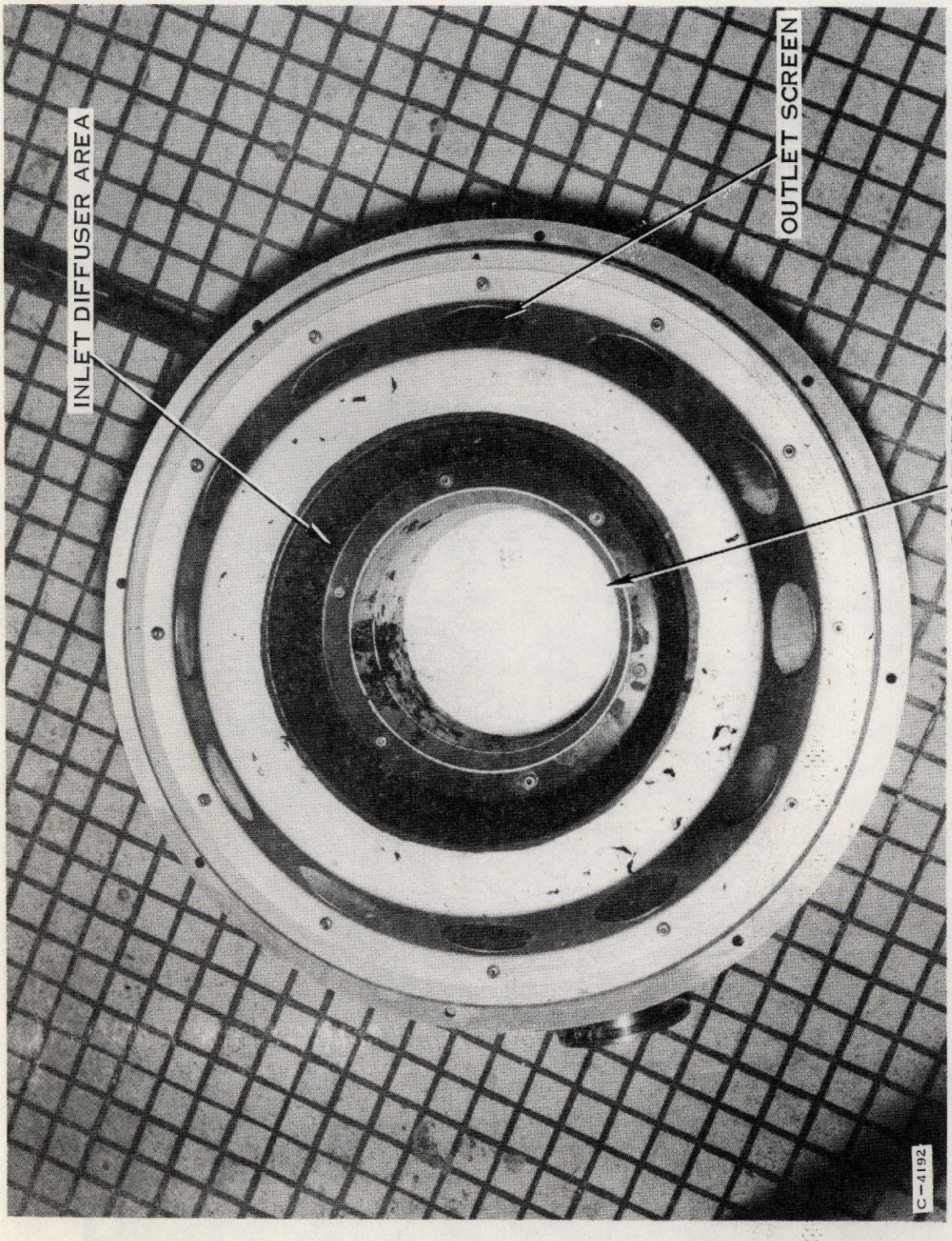

FIGURE 19. COMMODE AIR OUTLET SCREEN AND INLET DIFFUSION AREA AFTER 42 MAN-DAY ACCEPTANCE TEST

the material out of the commode. Most of this material was caught around the wipe retention devices and required pressure 3.08-4.46x10^5 N/m^2 (30-50 psig) to knock it free. Good agitation by the slinger would have had the same effect. At the conclusion of this process all that appeared left in the commode were stains on the metal surface.

The cleaning method used indicated that an in-place cleaning procedure could be devised that would be effective. It would require a motor with sufficient torque to operate the slinger in water, estimated as approximately 0.85 J (0.625 ft lbs), and a fixture with a nozzle which could rotate about the interior of the commode, to fit down into the fecal transfer duct. With this type of equipment and the proper ground support equipment an airline type servicing for the commode could be accomplished.

At the completion of the cleaning the commode was reassembled and the WCS was prepared for zero-gravity tests.

PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM ZERO-GRAVITY TESTS

Zero-gravity tests were conducted on the entire Preliminary Flight Prototype Waste Collection Subsystem to verify the ability of the WCS to collect waste products from male and female users in the zero-gravity environment and to perform all other functions required of the collection system in zero-gravity.

The testing was performed on the NASA Zero-Gravity Test Aircraft operated from Ellington Air Force Base. Sixteen test volunteers (13 female and three male) were utilized in the conduct of the test program. The test volunteers were Air Force Reserve personnel and Northrup Service Inc. employees located at NASA-JSC. The results of the test program are presented herein. In addition, a 16 mm edited and titled film with photographic data recorded during the test program is an integral portion of the test results.

Summary and Conclusions

The zero-gravity test program verified that the Preliminary Flight Prototype Waste Collection Subsystem was effective as a urine and feces collector for all users in the zero-gravity environment and that collection could be carried out in an earthlike manner. The testing demonstrated the acceptability and preference for a hard contoured commode seat and verified the need for foot and body restraints and hand holds to assist the user.

The user positioning-jet was found desirable for training but not required for a flight system. The testing generally verified that the design configuration of the Preliminary Flight Prototype WCS is an acceptable and usable design for the Space Shuttle vehicle.

The following were the specific test objectives for this test program:

- Verify the ability of the multi-position minimum flow urinal to collect urine from males and females in the zero-gravity environment.
- Verify the effectiveness of the feces collection portion of the system to separate and transfer feces to the storage/processor.
- Evaluate the effectiveness of the slinger and wipe retention devices in the zero-gravity environment.
- Evaluate the comfort and functional effectiveness of the hard contoured commode seat in zero-gravity.
- Determine the user restraint system required for zero-gravity operation.
- Evaluate the performance of the vortex liquid/air separator.
- Evaluate the effectiveness of the user positioning-jet in zero-gravity.
- Evaluate the performance of the urinal flush system in zero-gravity.
- Evaluate the overall usability of the WCS from a human engineering/human factors aspect.

The test program was carried out essentially in three phases; urine testing was accomplished initially, then feces simulator and urinal flush testing and then feces/urine testing. It should be noted that the Preliminary Flight Prototype WCS was not specifically constructed for zero-gravity tests, i.e. plexiglass construction to facilitate photographic coverage was not used; consequently the photographic coverage generally depicts success or failure but not detail. The subjective data therefore played an important part in the evaluation of the test results.

The test program led to the following specific test results and conclusions:

- The minimum flow, 7.08×10^{-3} m^3/s (15 scfm), movable non-intimate contact urinal is an effective urine collector in zero-gravity for male and female users and is a preferred configuration over urinals requiring intimate contact.
- The biggest effect on female urine collection is the position of the user.
- The urinal, while effective for male urine collection, was found to need more travel in the male position to provide for ease of use.
- The feces collection air entrainment flow of 9.44×10^{-3} m^3/s (20 scfm) was found to be effective for separation and transport of feces with a minimum of user and equipment soiling.
- The slinger and wipe retention devices were found effective in zero-gravity usage, with good distribution of wastes within the commode.
- The users had no difficulty mounting the commode or performing any of the functions required such as moving the urinal, opening the collector valve, etc. in zero-gravity and the unit was judged as earthlike and very easy to use.
- The majority of test volunteers thought that all restraint devices, foot holds, lapbelt and hand holds were required to aid in effective use of the system in zero-gravity and should be retained in a flight system.
- The test volunteers believed the hard contoured seat was acceptable for use in zero-gravity and by a wide margin (12 out of 15) preferred the hard contoured seat over a soft seat or a hard non-contoured seat.
- The test volunteers found the user positioning-jets helpful in getting used to the system but did not think they were required, unless strictly as a training aid, in a flight system.
- The urinal flush was found effective as long as water pressure was set at 3.08×10^5 N/m^2 (30 psig) and the cover was closed; at lower pressure and with the cover open an effective flush was not attained.
- The vortex liquid-air separator operated without difficulty throughout the test program and there was no evidence of liquid carry-over.

Discussion of Test Results

The detail test procedure is contained in Appendix F and describes the test sequences and data sheets utilized in the conduct of the test program. In addition to the Preliminary Flight Prototype WCS, a water supply package was assembled from components utilized in the seat/urinal zero-gravity tests discussed in the first section of this report. Also utilized was the privacy enclosure used during the seat/urinal tests. Figures 20 and 21 depict the total installation in the zero-gravity test aircraft. Figure 22 shows the front camera location while the view from the frontal camera location may be seen in figure 23. The photographic data was obtained with a close-up lens, which gave fairly good coverage of the pubic and scrotum areas during use of the system. The rear camera lens coming through the enclosure is visible in figure 23 also. The basic purpose of the rear camera was to show buttock position and sealing during feces collection and also gave an indication of subject position and movement that could influence system performance during the zero-gravity maneuvers.

All test runs were recorded photographically by the two fixed cameras. In addition a hand held camera was used to record any aspects of the testing not being recorded by the fixed position cameras. The primary means of understanding the test results is by viewing the photographic data recorded during the flight testing. A 16 mm film has been prepared that presents salient portions of the subjective tests. Appendix G contains copies of the subjective comments recorded on the actual data sheets during this test series. These comments were the other primary means of obtaining data during the test program.

There were sixteen test volunteers utilized during this test series, excluding two Hamilton Standard personnel. Of the sixteen, 13 were females and three males. The test volunteers encompassed an excellent cross-section of sizes ranging from the smallest at 1.58 m (62.5 in.) and 47.6 kg (105 lbs) to the largest at 1.95 m (77 in.) and 111.1 kg (245 lbs). Included in Appendix G is a listing of test volunteer weights and heights. Physical size did not have any influence on the collection capability of the system. The majority of test volunteers had previous zero-gravity experience, specifically in waste collection testing. It is believed that this experience helped immeasurably, allowing the completion of testing within the limited number of flights. A total of nine flights was accomplished encompassing 280 zero-gravity maneuvers, and all test objectives were achieved.

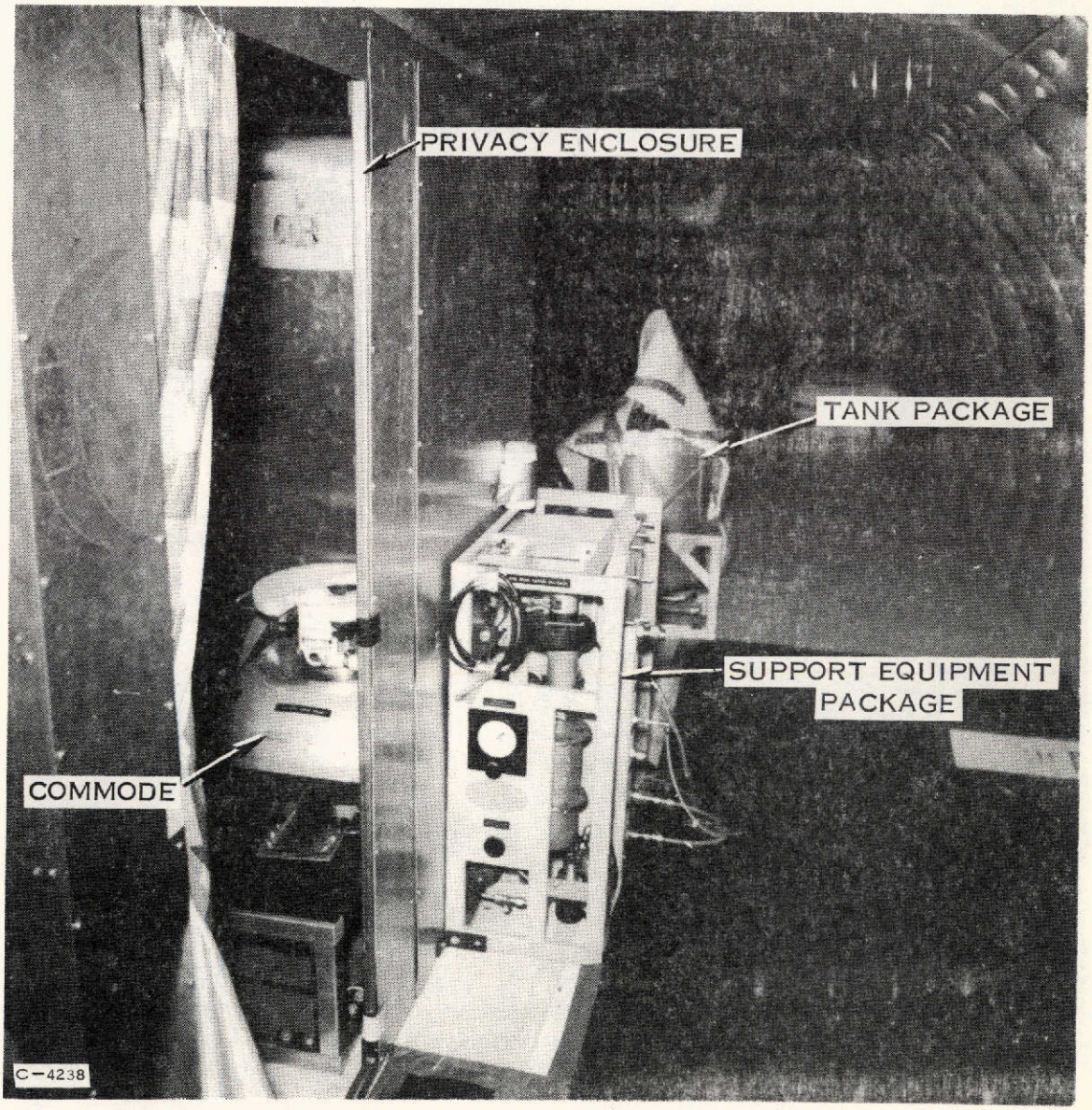

FIGURE 20. PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM ZERO-GRAVITY AIRCRAFT TEST INSTALLATION - FRONT VIEW

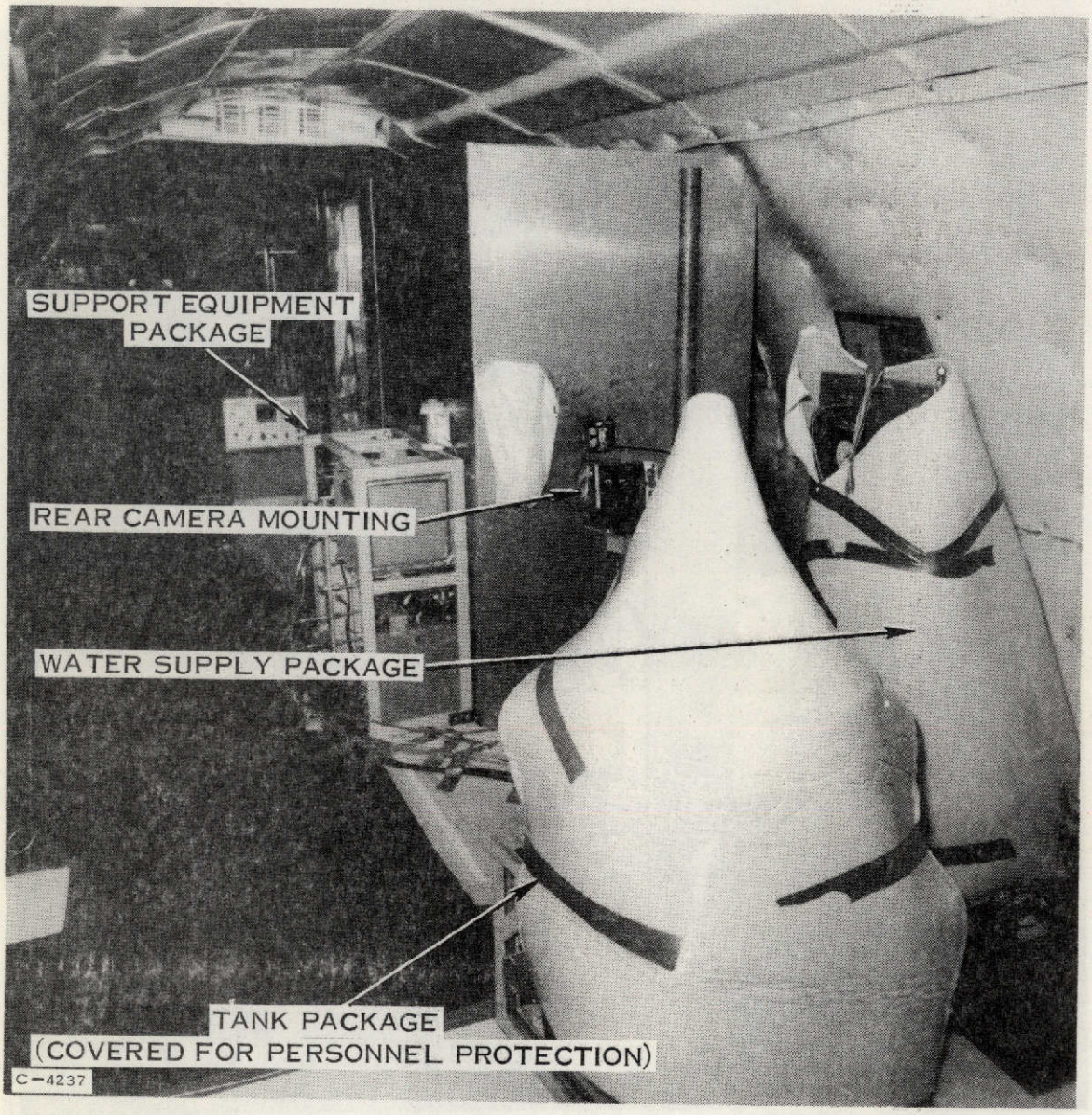

FIGURE 21. PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM ZERO-GRAVITY TEST AIRCRAFT INSTALLATION- REAR VIEW

FIGURE 22. PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM FRONT CAMERA LOCATION FOR ZERO-GRAVITY TESTS

FIGURE 23. PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM FRONT CAMERA VIEW DURING ZERO-GRAVITY TESTS

Urine Collection Tests

The urine tests were conducted initially with urine collection as the only test objective and subsequently in conjunction with feces testing. In total, 46 individual urinations were recorded along with 13 urinations accomplished with the defecations. Included in this total are five male urinations. The urinations were collected during 101 zero-gravity maneuvers, which therefore actually means that 101 urinations were achieved.

Analysis of the female urination test films indicated that only one urination was not collected by the system. The first test volunteer, on the first maneuver flown of the test program, had urine come over the front top of the urinal and escape into the privacy enclosure. She managed to wipe it up and the urinal did collect from her successfully in the second and third parabolas and also on the next day. Analysis of the test films revealed that the urine was being collected by the urinal until there was a shift in subject position, whereupon the urine stream moved to a position parallel with the top of the urinal. This test volunteer also reported in her final write-up that she "had to watch to see how it worked". It became apparent from the films and the volunteer's comments that she was totally out of position due to her desire to watch the urination. For a female subject to watch her urination she would have to sit back from the urinal and also rotate the urethra upward, which could explain the urine working its way up over the top of the urinal.

Three of the test volunteers reported that in the early days of the tests they surmised that some of the urine was going into the fecal collection opening because they thought they felt damp in the perineal area. It was difficult for them to be certain because the aircraft was quite cold (approximately 490°K (55°F) at the start of testing on several of the days) and consequently the test volunteers all complained of cold airflow. This parameter was not under control of the WCS because aircraft cabin ambient air was used as the source of air supply. To check for urine entering the fecal collection opening on subsequent days, the slinger was not operated and a plastic bag was placed in the feces collection opening. On the second day of testing approximately 90 to 120 ml of urine were found in the bag; on the next day 30 to 60 ml was contained.

Analysis of the test films again revealed that the volunteers who had this problem genrally were sitting with their legs far apart at the urinal, were sitting too high (not in contact with the seat) or moving a lot, indicating they were not holding themselves down enough with the hand holds and lap belt. As the testing progressed comments of this type tended to disappear and the photographic data revealed that the test volunteers were holding their position better.

Only one test volunteer repeatedly reported problems with feeling excessively wet in the vulva area or that she thought some urine was going back over her buttocks or to the perineal area. Analysis of the data recorded by the front camera in some cases revealed some splashing, although no urine escaped from the collector, but did not reveal the problem. Inspection of the data recorded on the rear camera, however, did reveal that while this test volunteer was down firmly on the seat and not bouncing around, her buttocks were hanging over the back edge of the seat of the seat. Since this did not happen with even the largest test volunteer the only possible answer for her difficulty was that she was sitting too far to the rear and not getting proper urine entrainment airflow.

In general, the urinal with a design flow of 7.08×10^{-3} m^3/s (15 scfm) collected urine very successfully from the female test volunteers. Once again the importance of proper position was illustrated. As long as a test volunteer was positioned properly the system worked without difficulty; if the subject was not properly positioned excessive wetting occurred or urine went into the feces collection opening.

Collection of male urinations was not a problem for the urinal at an airflow of 7.08×10^{-3} m^3/s (15 scfm). The urine was even collected when the end of the penis was not within the plane of the top surface of the urinal and when droplets were shook off the penis 5.08 to 7.62×10^{-2} m (2.0 to 3.0 in.) above the urinal. However, it was found that the urinal did not have sufficient travel in the male collection attitude, which made male collection somewhat difficult. The ideal position of the urinal for the male is to have the urinal in a vertical attitude. This attitude was found totally acceptable as it existed in the male detented position. However, as the urinal is brought closer to the user it started to attain a horizontal attitude to achieve the female position. All the male test volunteers found the detented position too far away from the user; however, bringing the urinal closer put it into a somewhat awkward position for usage. In future designs the movable urinal must incorporate a linkage that allows the urinal to maintain the vertical attitude for the male in any location near the feces collection opening or further away. In addition, there is no requirement for a detented position; the mounting must allow the urinal to remain in any position.

Copies of the subjective test data sheets utilized during the urine collection testing are contained in Appendix G of this report.

Feces Simulator and Urinal Flush Tests

At the completion of the urine collection tests "unmanned" runs were made to gain confidence in the feces air entrainment capability prior to test volunteer usage and to evaluate the urinal flush system. The fixed cameras were not of much use during these tests and most data was obtained by test conductor observation and hand held camera.

Twenty zero-gravity maneuvers were utilized in the feces simulator tests. Approximately five pounds of simulated feces in form varying from a hard to a diarrhetic type elimination were put into the commode opening. In all cases the feces entrainment airflow carried the simulated stools into the storage/processor. It was found that if the fecal collection opening were totally open, i.e. not sealed by the buttocks, the feces would stay at the entrance to the fecal transfer duct and start to tumble. When the opening was blocked 75 percent or more by a piece of plexiglass the simulated stools were instantly carried by the airflow down into the storage/processor. In addition to the simulated feces, approximately two dozen "Skylab Wipes" were put into the commode during zero-gravity. The testing proved to be an excellent indication of system operation and gave confidence that fecal collection would not be a problem with the test volunteers.

The urinal flush was also photographed during this flight activity. The flush was accomplished at both 2.39×10^5 N/m^2 (20 psig) and 3.0×10^5 N/m^2 (30 psig) water pressure, both with the urinal cover on and off, utilizing a plexiglass cover. It was found that the flushing action was much more effective at 3.0×10^5 N/m^2 (30 psig) than at 2.39×10^5 N/m^2 (20 psig). However, with the cover open the flush did not give effective coverage even at 3.0×10^5 N/m^2 (30 psig) water pressure. The flush was characteristic of flushing tests conducted on the ground and the only way to improve the flush action with the cover off would be to increase the urinal airflow. Consequently it is concluded that the optimum flush for the present airflow is with the cover on and water supply pressure at 3.0×10^5 N/m^2 (30 psig).

At the completion of the unmanned testing the commode was opened and the simulated feces and wipes distribution inspected. A very uniform distribution of the mixture was found around the whole commode with the mixture still adhered to the wall, even after the pullouts. Wipes were found either mixed in the simulated fecal matter or caught on the wipe retention devices. Very little matter, estimated at less than five percent, was found on the bottom of the collector and there was no material caught in the air-entrainment air-outlet screen. Figure 24 depicts the simulated feces and wipes on the sides of the collector and figure 25 shows the outlet screen. It was concluded from these test results that the slinger, air-entrainment flow and wipe retention devices were performing in zero-gravity as designed.

Feces Collection Tests

Prior to the start of the feces collection tests the commode was cleaned of the wipes and simulated feces. No plans were made to vacuum-dry the feces during the flight test program. Vacuum-drying was not attempted on the aircraft due to the difficulties associated with operating a conventional oil type vacuum pump during the zero-g and 2-g periods of flight. Vacuum-drying between flights would have involved removing the commode assembly and support equipment package daily which would not have been practical

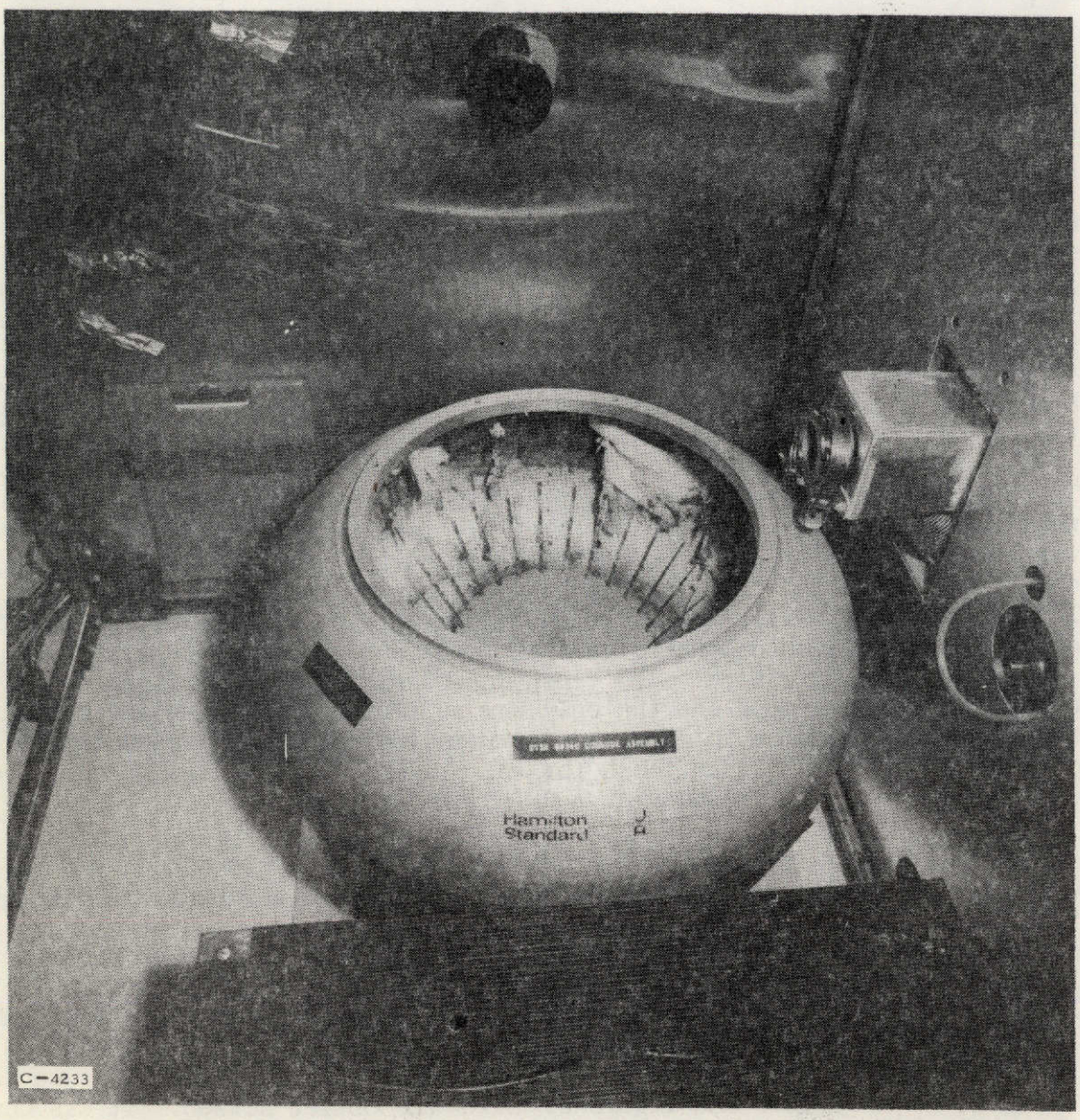

FIGURE 24. DISTRIBUTION OF WIPES AND SIMULATED FECES IN COMMODE AFTER ZERO-GRAVITY TEST

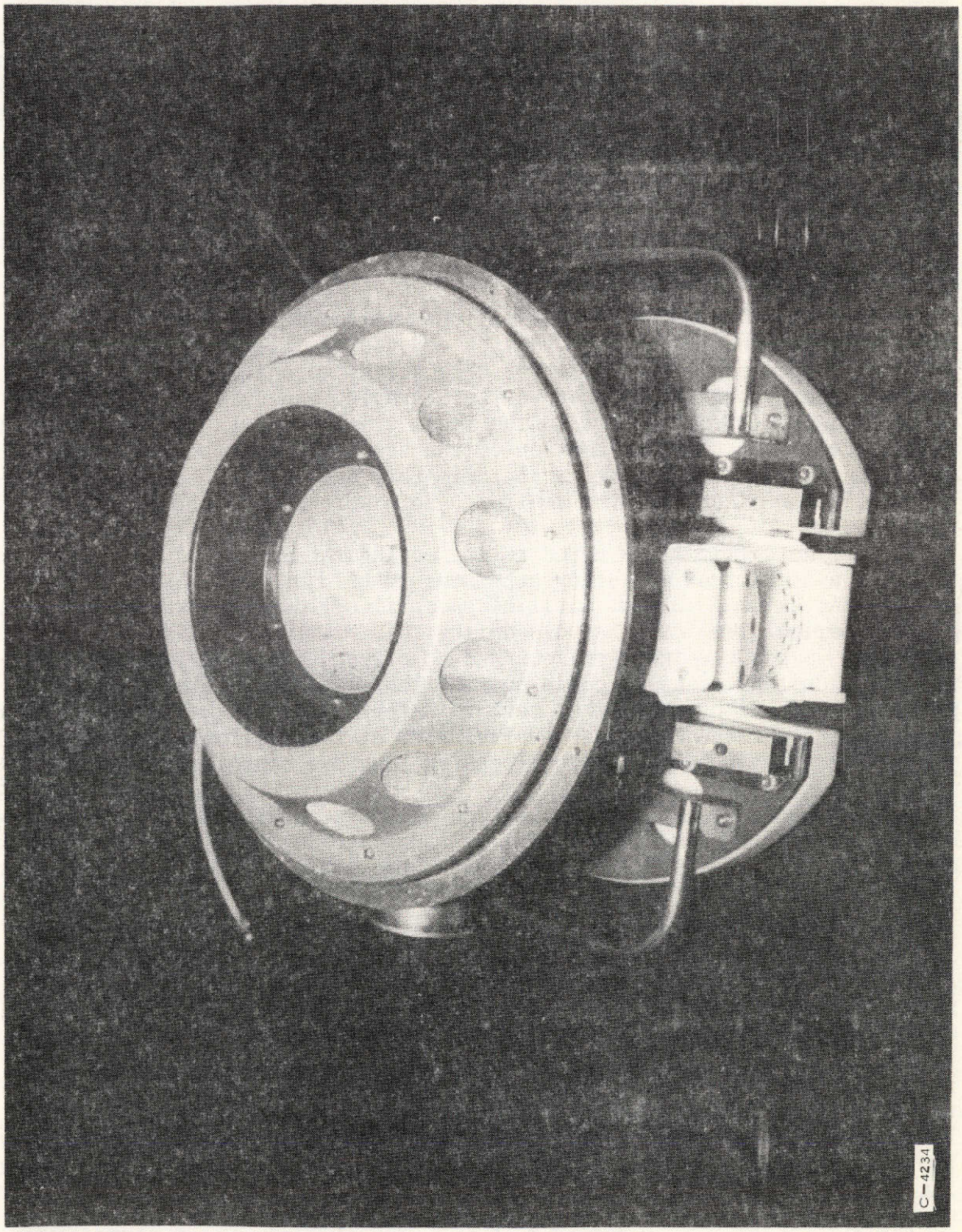

FIGURE 25. COMMODE AIR OUTLET SCREEN AND INLET DIFFUSION AREA AFTER SIMULATED FECES TEST IN ZERO-GRAVITY

from a time standpoint. Consequently, it was decided not to vacuum-dry but to let the feces accumulate throughout the test program and clean the commode only at the completion of testing. Since the simulated feces test already had verified the capability of slinger and wipe retention devices, the fact that non-drying of the feces would probably cause the feces to slide down the commode walls during the flight periods where over one-g was experienced would not be crucial to the test results. To control any possible odors or bacteria buildup 60 ml of a disinfectant (Lysol Brand, Concentrated) were poured into the commode daily at the completion of the testing and distributed internally by the slinger.

A total of thirteen defecation/urinations was accomplished during the WCS test. Eleven were recorded by females and two by male test volunteers. The defecations ranged from normal-type defecations to one that was a diarrhetic-type movement lasting through three zero-gravity maneuvers. There were only two instances of fecal smears on the fecal transfer duct. In both cases the smear appeared on the rear portion of the transfer duct. One was recorded during the diarrhetic movement, approximately 0.64 by 1.27×10^{-2} m (0.25 by 0.50 in.); the other was even smaller. Both were easily removed with a wipe.

There were no difficulties noted in collecting the feces. One male subject reported a stool that would not separate; it held on through both zero-gravity and a two-g pullout until he shook it off during a subsequent zero-gravity period. Two other stools during this elimination did separate properly. Since the two-g pullout had no effect, it is obvious that this stool wouldn't have separated in one-g either, and that this was just an unusual elimination. One other test volunteer reported that she wasn't sure if a stool separated during zero-gravity or at the pullout. Copies of all test subject data sheets for the feces testing are contained in Appendix G.

It was concluded from the fecal testing conducted that the feces entrainment airflow of 9.44×10^{-3} m^3/s (20 scfm) was adequate for separation, entrainment and transport of the stool to the storage/processing area. The test volunteers also reported adequate access for wiping and wipe disposal. Sixty-three "Skylab" wipes were deposited into the commode during these tests.

At the completion of the feces collection tests the equipment was removed from the zero-gravity test aircraft and inspected prior to cleaning. As expected, approximately 50 percent of the feces deposited had slipped from the walls and into the lower trough of the collector. However, even with the two-g pullouts and aircraft vibrations and landing loads, the remainder of the feces was stuck to the walls in a uniform pattern. The wipes were uniformly distributed about the commode and were located on the retaining spikes, which again verified the effectiveness of the retaining spikes in controlling wipe distribution and packing. Figure 26 depicts a portion of the commode wall with feces and wipes retained. The outlet screen was inspected and found generally free of any debris, as shown in figure 27.

FIGURE 26. FECES AND WIPE DISTRIBUTION IN COMMODE AFTER ZERO-GRAVITY TESTS

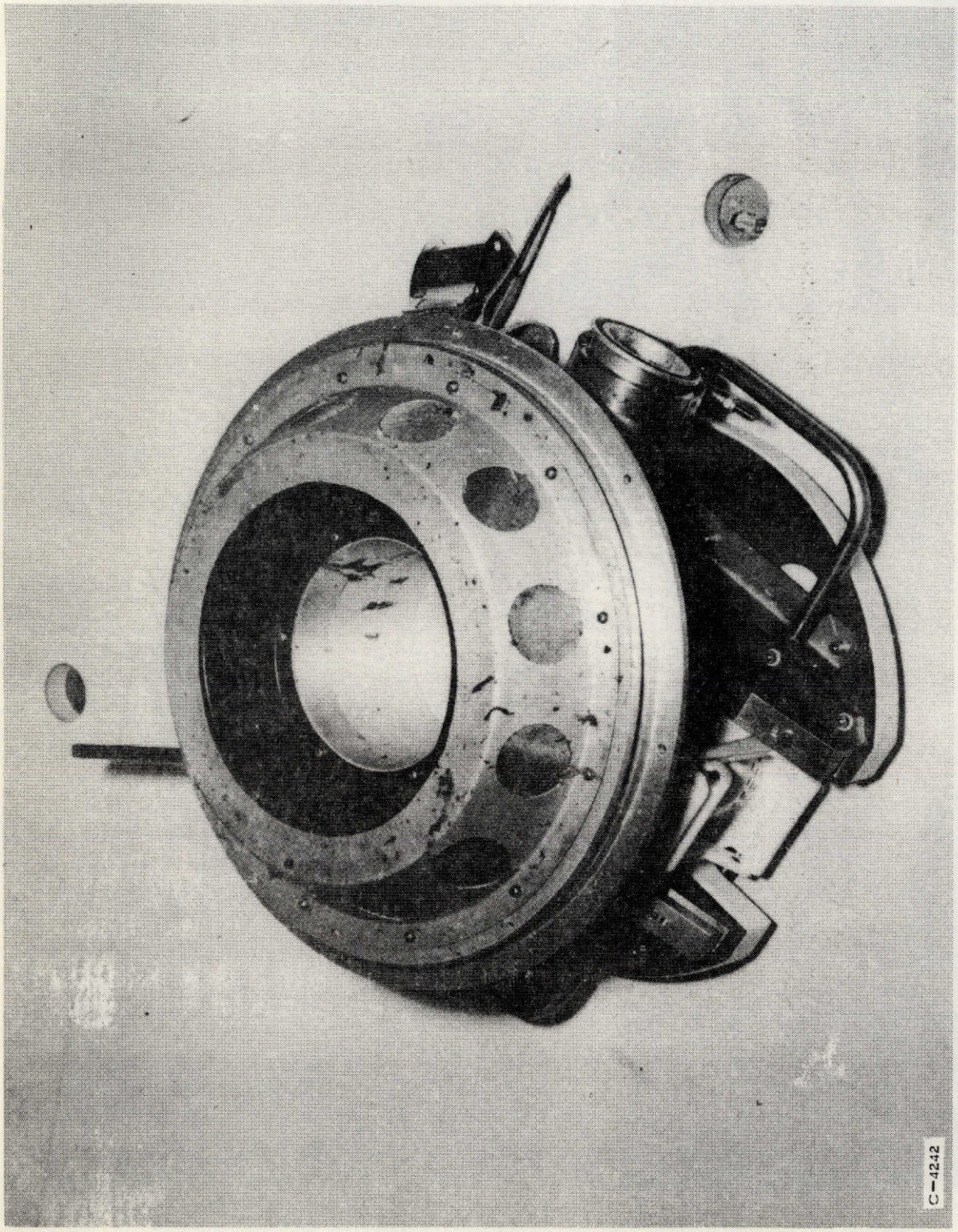

FIGURE 27. COMMODE AIR OUTLET SCREEN AND INLET DIFFUSION AREA AFTER FECES COLLECTION TESTS IN ZERO-GRAVITY

Once the inspection was completed the unit again was successfully cleaned using a hose and the cleaning drain, and then prepared for shipment to Hamilton Standard.

At the completion of the feces tests several of the test volunteers were photographed seated on the unit in one-g. The photographs indicate that even with the restraint devices the users sit in a more settled or lower position in one-g than in zero-gravity. A comparison of the zero versus one-g position is presented in the test data film.

At the completion of the test program each test volunteer was requested to write a general opinion of the acceptability of the Preliminary Flight Prototype WCS. All test volunteers thought the system was acceptable for use. In general, the volunteers liked the ease of usage, and the female test volunteers in particular thought the non-intimate contact feature very good. The male test volunteers reported the urinal did need more adjustment and that it was marginally acceptable for usage with the available adjustment. The test volunteers were specifically questioned with respect to the hard seat, the restraint devices and the positioning-jet. The test volunteers all thought the hard contoured seat was acceptable for use. It was concluded from the comments of the test volunteers that the three-way restraint system (foot restraints, lap belt and hand holds) was needed and that these were the proper methods for spacecraft usage. Not all the test volunteers utilized all three restraint methods at all times but they all felt the three-way system necessary. With respect to the positioning-jet system the majority of the test volunteers didn't feel it was absolutely necessary. They felt it was a good training aid and an excellent confidence builder but that once an individual became accustomed to the system it wasn't really required. Appendix H contains copies of the actual comment sheets written by the test volunteers. There were no problems with any other parts of the system; the users had no difficulty operating the commode, becoming seated, or moving the urinal. A film sequence showing one of the volunteers performing these actions is included in the test data film. One volunteer during the feces tests complained of a formaldehyde-type odor emitting from the commode. The odor was found to be created by the disinfectant/bactericide that was being sprayed into the commode to control the odors. There were no equipment failures of any kind during the flight test program.

Overall, the Preliminary Flight Prototype Waste Collection Subsystem demonstrated its ability to successfully collect waste products from male and female subjects in zero-gravity effectively without problems.

QUALITY ASSURANCE

In the conduct of the Preliminary Flight Prototype Waste Collection Subsystem the primary effect of the quality assurance effort was felt in the design studies, trade-off analysis and system analysis areas. All designs were reviewed by quality assurance personnel prior to release for manufacture. An example of the type of changes initiated by quality assurance was the substitution of the rotating gate for the collector valve as opposed to a sliding gate valve, which would exhibit poor seal wear tendencies. All equipment was inspected by quality control for compliance to blueprints or purchase orders prior to installation in the assembly. The effect of the quality effort was readily evident in that the system operated without problems during the zero-gravity test series.

RELIABILITY

In the conduct of this program the reliability effort was concerned primarily with providing an on-going analysis of the components utilized to insure that system operational life would not be compromised. Areas of concern that came under scrutiny were the electronic parts in the controller; while hi-rel electronics were not procured in the interest of program economy; high quality components were utilized. Other areas such as valve seat materials were reviewed to insure minimum leakage through the usage life. In general, in the conduct of the Preliminary Flight Prototype Waste Collection Subsystem program reliability was utilized as a design tool in selecting components on concepts employed.

SYSTEM SAFETY

The Preliminary Flight Prototype Waste Collection Subsystem considered overall safety in the actual design of the unit, which was designed fail-safe. Personnel are protected against vacuum by a user operated manual gate valve. The use of a manual, user-operated gate valve eliminates the possibility of an electrical malfunction or another crew member opening the valve. In addition, the user is given status indications to let him know when it is safe to open the gate valve. If the user ignores the indicators he will find it necessary to exert over 88.9 N (20 lbs) of force to open the collector valve. If the user still persists in opening the valve he is protected by the fact that a short circuit is provided through the feces air entrainment openings in the fecal transfer duct. The area of the openings in the fecal transfer duct is seven times that of the vacuum line opening, thereby insuring sufficient air will enter the commode to offset the air escaping to vacuum and preventing a delta pressure on the user.

Personnel are protected against fracture of rotating elements both by low stresses and by containment. Pressure vessels are limited in pressure input and are protected by relief valving. Gas velocities are limited by design. Bacteria are killed or inhibited. The electrical system is protected by fusing and the individual pieces of equipment are grounded.

Review of the WCS design and operation will verify that a safe system has been produced.

INTERFACE REQUIREMENTS

The interfaces required to provide for the operation of the Preliminary Flight Prototype WCS are depicted on the schematic of figure 12. The operation of the system requires five external interfaces.

• Vacuum source	less than 1.72×10^5 N/m^2 (0.25 psia)
• Nitrogen or air supply	3.08×10^5 N/m^2 (30 psig) minimum
• Water supply for urinal flush	3.08×10^5 N/m^2 (20 psig) minimum, 3.78×10^{-2} kg/s (5 lb/min.) flow rate
• Power supply	115 Vac, 400 Hertz, 3 phase and 28 Vdc
• Urine/water drain	

The floor area required for the prototype WCS is 1.12 m (44 in.) by 1.17 m (46 in.) for the commode assembly and support equipment package. The tank package requires a 0.61 by 0.61 m (24 by 24 in.) floor area and location is not critical with respect to the other equipment.

The following interfaces are presently considered as required for an actual flight installation of the WCS.

• Vacuum line to exterior of vehicle	1.27×10^{-2} m (0.50 in.) diameter or containing a 1.27×10^{-2} m (0.50 in.) orifice
• Power supply	115 Vac, 400 Hertz, 3 phase and 28 Vdc
• Waste liquid drain line	

It should be noted that as a result of the zero-gravity test program the gas supply for the positioning-jet was eliminated. Also, the urinal flush water supply was eliminated as connection to the vehicle water supply may not be allowed. Consequently the interfaces listed are those absolutely required to operate a flight WCS. A possible ground interface may be desired to allow in-place cleaning of the commode.

The envelope of a flight WCS depends entirely on the mission definition. However, it is believed that a system, less waste liquid storage tankage, could fit in a volume of 0.35 m^3 (12 ft^3) or less if normal mission length does not exceed 210 man-days. It is estimated that the weight of such a system would be under 34 kg (75 lbs).

APPENDIX A

SUBJECTIVE COMMENTS FROM DEVELOPMENT UNIT SEAT/URINAL ZERO-GRAVITY TESTS

Hamilton Standard — Division of United Aircraft Corporation

Test Subject No.: _____

Date: _____ Data Sheet No.: _____ Run No.: _____

Subject Comments

a) Was micturation accomplished? Yes _____ No _____

b) Was there any backsplash onto yourself or the seat during collection? Yes _____ No _____ If yes, estimate quantity and describe location and pattern of contamination.

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No _____ If yes, estimate quantity and describe location and pattern of contamination.

d) Was the primary air flow: comfortable _____; uncomfortable _____. Describe/explain.

e) Was the backflow air stream : comfortable?____ uncomfortable?____ Describe/explain.

f) Was the seat comfortable during collection? Yes _____ No _____ Describe/explain.

g) Were the provided restraint devices effective during collection? Yes _____ No _____ What restraint devices were used during zero-gravity collection? foot _____; hand _____; combination _____.

h) General comments on the performance of the urinal during zero-gravity periods.

SUBJECTIVE DATA SHEET DEVELOPMENT UNIT
SEAT/URINAL ZERO-GRAVITY TESTS

SEAT/URINAL ZERO-GRAVITY TEST SUBJECTIVE COMMENTS

Test Flight	Entrainment Airflow		Test Subject	Comment
	Primary	Backflow		
1	131 cfm	8.1 cfm	H.M.D.	Somewhat uncomfortable due to suction sensation, good collection performance.
1	131 cfm	8.1 cfm	J.M.M.	It was very comfortable throughout the parabolas, no collection problems.
1	131 cfm	8.1 cfm	E.McC.	Primary flow was a little cool but I would not say it was uncomfortable. Backflow was comfortable, but I thought it was strong, a funny sensation but not uncomfortable. During zero-gravity I had to use hand holds, foot restraints were not enough to keep me on the seat. Urinal worked O.K.,- no complaints at this time.
1	131 cfm	8.1 cfm	J.H.B.	No urination, airflow comfortable.
1	131 cfm	8.1 cfm	C.S.H.	Airflow felt warm - giving sensation to stimulate voiding, didn't note any difference between seat and regular commode seat.
2	99 cfm	5.1 cfm	H.M.D.	Very small amount of urine on pubic area - no more than normal voiding. This time I did not have sensation of suction. No problems - works adequately.
2	99 cfm	5.1 cfm	J.M.M.	A sprinkling of urine upon full force micturition on thighs and buttocks - none on seat. I felt more comfortable and more at ease this time around.
2	99 cfm	5.1 cfm	E.McC.	Urinal O.K., could backflow possibly be made colder - it might help as to void more. (See Note A).

SEAT/URINAL ZERO-GRAVITY TEST SUBJECTIVE COMMENTS (CONTINUED)

Test Flight	Entrainment Airflow		Test Subject	Comment
	Primary	Backflow		
2	99 cfm	5.1 cfm	C.S.H.	Air needs to be cooler, I felt this was my reason for not voiding (See Note A).
2	99 cfm	5.1 cfm	J.H.B.	Airflow could be cooler (See Note A).
3	74 cfm	4 cfm	H.M.D.	Entire void collected at upper right thigh for entire zero-gravity period.
3	82 cfm	4 cfm	J.H.B.	Airflow does not seem to work as well in early low pressure part of void, urine drops down and runs down back inside surface of urinal, works well in mid-stream, no backsplash or pooling occurred.
3	82 cfm	4 cfm	L.J.B.	Got small amount of backsplash on left thigh, estimate less than 5 cc.
3	82 cfm	4 cfm	M.G.F.	Urinal and seat very comfortable - no problems encountered.
3	82 cfm	4 cfm	J.M.M.	No backsplash but pubic area felt damp.
3	82 cfm	4 cfm	E.McC.	Urinal O.K., only problem I have is getting settled back onto the seat after initiation of zero-gravity. I find I bounce around a little and need time to get seated properly.
3	82 cfm	4 cfm	C.S.H.	Urinal proved adequate for me during zero-gravity. I was unable to complete void during one parabola and took several parabolas with no difficulties during any of them.

SEAT/URINAL ZERO-GRAVITY TEST SUBJECTIVE COMMENTS (CONCLUDED)

Test Flight	Entrainment Airflow		Test Subject	Comment
	Primary	Backflow		
4	74 cfm	4 cfm	H.M.D.	Urine pooled at area of crease at right thigh and buttocks - did not collect until zero-gravity period was over. Do not like this airflow.
4	74 cfm	4 cfm	M.G.F.	No problem - large void.
4	74 cfm	4 cfm	J.H.B.	Airflows seemed to be quite effective in directing the urine stream down the urinal.
4	74 cfm	4 cfm	A.M.S.	Slight splash inner aspect of groin. I think a waist type restraint would be helpful.
4	74 cfm	4 cfm	J.M.M.	Watched micturition and urine appeared to form round ball-like objects and flowed straight down the urinal. It felt very normal in every way when micturating.
4	74 cfm	4 cfm	E.McC.	Urine collected with no problem, backflow seemed very effective today. I also felt very comfortable today.
4	74 cfm	0	K.C.J. (Male)	No difficulty with male collection.
5	74 cfm	4 cfm	H.M.D.	On voidings during second and third parabolas entire specimen pooled on thighs. (See Note B).

Flight Tests Terminated Due to Aircraft Unavailability.

Notes:

A. Subjects comments on temperature were due to malfunctioning aircraft heater operating temperatures over 80°F in cabin.

B. This subject was checked again at these conditions because on previous days (flight #4) she had collection problem but all other subjects had no problems. No further tests were made due to A/C problems.

APPENDIX B

SUBSYSTEM REQUIREMENTS SPECIFICATION FOR PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM

Hamilton Standard
DIVISION OF UNITED AIRCRAFT CORPORATION

SUBSYSTEM REQUIREMENTS SPECIFICATION

SPACE SHUTTLE PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM

for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS 77058

CONTRACT NAS 9-12938

FEBRUARY 1973

Prepared by: Joseph E. Swider, Jr.
Program Engineer

Approved by: F. H. Greenwood and A. F. Behrend
F. H. Greenwood
Program Manager

A. F. Behrend
Technical Monitor
NASA, MSC

INTRODUCTION

The Space Shuttle Preliminary Flight Prototype Waste Collection Subsystem must provide for the collection, transport, separation, treatment and storage of urine, feces and vomitus, post-elimination cleansing of the body and control of odors and bacteria. It must do this in a manner which is as earthlike as possible.

This document presents the general operation requirements of the Preliminary Flight Prototype WCS. These requirements have been derived from the results of: 1) ground tests conducted under Contract NAS 9-12150, Waste Collection Subsystem Development; 2) zero-gravity testing of the urinal equipment developed under Contract NAS 9-12150; and 3) review of the Shuttle orbiter requirements being utilized by the Shuttle Vehicle Prime Contractor.

PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM

OPERATIONAL REQUIREMENTS

GENERAL REQUIREMENTS

1. The unit must accommodate both male and female adult passengers in both one-g and zero-g environments.

2. No reclamation of the metabolic waste products is required.

3. The unit should be as earthlike as possible in the human operation aspects and have a clean and acceptable appearance. Usage shall not require any manual handling of bagged metabolic wastes. A

4. The Flight Prototype WCS will not contain any redundant components as would be contained in a flight system.

5. The Flight Prototype WCS shall consider maintenance from a ground servicing aspect. Maintenance provisions that can be designed into the unit will be incorporated; any ground servicing equipment required will not be designed or included as part of the Flight Prototype.

6. Solid waste products shall be stored onboard the spacecraft for return to earth and shall not be dumped to space.

7. Microbiological and bacterial growth in organic waste products shall be inhibited; contaminated waste material shall be disinfected or processed as close as possible to its original source.

8. The Flight Prototype WCS equipment will be accessible for maintenance and repair.

9. The Flight Prototype WCS shall incorporate a control scheme that allows the user to control startup and shutdown of the system. Any time controlled sequences will be accomplished by manually variable timers to allow test flexibility.

10. The Flight Prototype WCS shall be designed compatible with Shuttle power supply: 28 volt DC or 400 cycle, 115/200 volt, three phase AC shall be specified for all electrical components.

11. All electrical areas shall employ safe design, i.e., fuses, proper grounding, etc.

12. The following crewmember metabolic waste products will be handled by the WCS. Nominal values shall be used in WCS design.

a) Urine produced (lb/man-day)

1) Water

i Nominal design point (48 hour average)	3.31
ii Range	1.26-5.29

2) Solids

i Nominal design point (48 hour average)	0.13
ii Range	0.06-0.22

3) Frequency - urinations per man-day

i Nominal design point (48 hour average)	5
ii Range	3-7

4) Maximum urine flow rate (lb/sec) 0.088

b) Feces produced (lb/man-day)

1) Water

i Nominal design point (48 hour average)	0.20
ii Range	0.13-0.44

2) Solids

i Nominal design point (48 hour average)	0.07
ii Range	0.04-0.15

3) Frequency of defecations per man-day

i Nominal design point (48 hour average)	1
ii Range	0-2

c) Vomitus produced

i Occurs at infrequent intervals; up to 900 cc per occurrence

FECAL COLLECTION

1. Commode shall have the capacity to contain and process the following:

120 man-days of feces:	Total design weight	32.4 lbs	A
	water weight	24.0 lbs	A
	solids weight	8.4 lbs	A
120 man-days of wipes:	Total design weight	3.84 lbs	
	fecal elimination wipes	1.92 lbs	
	female vulva wipes	1.92 lbs	
120 man-days of vomitus:	Total design volume	10,800 cc	
	maximum volume per occurrence	900 cc	

NOTE: The 120 man-day requirement is derived from the maximum possible mission as defined by the Shuttle prime contractor. The penalty paid for one commode to handle this case is small as compared with a nominal mission commode of 42 man-day capacity and the addition of another commode for longer missions.

2. The feces processing method shall be vacuum drying.

3. The commode shall be capable of collecting and storing feces for up to twelve hours in a non-venting mode of operation without degradation or operation or performance.

4. The time of venting between non-venting periods will be four hours. The design shall insure that adequate vacuum drying to inhibit bacteria growth takes place in this time period. A

5. There will be no time limit between eliminations other than equipment cycling.

6. The post-elimination cleansing method will be the use of wipes. They will be disposed of in the commode.

7. Feces will be separated at the anus and transferred to the storage/processor via air entrainment.

   Minimum entrainment flow at 14.7 psia and 70°F.... 15 cfm

8. The fecal collection hole and transfer duct will be four inches in diameter. The design shall insure that this is adequate for collection and movement of feces without excess soiling on surfaces.

9. The commode shall incorporate a slinger/shredder that will spread feces evenly about the storage area and will impart a shredding action upon the wipes.

10. The fecal collector shall incorporate a positioning device to allow proper location of the anus over the collection opening. The positioning device will be gas jets; the locating jet pressure range shall be adjustable between 10 to 50 psig. The locating jet time of operation will be controlled by the user.

11. The commode shall incorporate filter screens internally to minimize particles which might exit to vacuum or through the fan to the odor control and bacteria filters.

12. Safety:

    a) There shall be indicator lights incorporated on the control panel which will indicate when the commode is at vacuum and when the system is at ambient pressure and ready for use.

    b) The commode assembly shall incorporate an electrical ground to protect users against shock.

    c) The vacuum line shall be orificed to eliminate the chance of the user being exposed to low pressure, i.e., vacuum, in the event of valve or power failures.

URINE COLLECTION

1. The urine collector shall start no more than 2.25 inches from the center of the fecal collection opening.

2. Urine shall be collected and moved to the storage tank utilizing air entrainment as the transport median.

3. The entrainment scheme shall provide flow from two directions directed toward the female vulva area. Flows shall be based on standard conditions and shall be sufficient to minimize urine residual on the female vulva area to 6 ml. As a design objective the entrainment flow shall not exceed 25 cfm at 14.7 psia and 70°F.

4. The entrainment flow will be controlled to provide a flow velocity of 26 ft/sec on the urinal walls.

5. The urinal shall be cleaned by a rinse of water and biocide; amount of fluid used per rinse will be 0.40 lbs, maximum. The rinse solution flow rate will vary between 3.2 to 10.0 lbs/min. A

6. The urinal rinse system shall include a biocide supply with a 120 man-day capacity. Water will be provided from the vehicle water system; minimum pressure required will be 20 psig. The biocide will be added to the system. The user will initiate the rinse cycle. The rinse cycle shall shutdown automatically.

7. Fluid/air separation shall be accomplished by a Vortex fluid/air separator. Separated fluid will be pumped to a storage tank; the air will pass through the odor control filters to the cabin.

8. Urine and rinse fluid shall be stored in a tank with a 42 man-day minimum capacity. If the mission length exceeds this capacity, dumping of the tank will be permitted. Capacity shall be as follows:

Urine in tank -	145.0	lbs
Rinse solution in tank -	84.0	lbs
Total tank fluid capacity -	229.0	lbs

9. The urine collector shall incorporate, if feasibile, some clear wall area to allow photographic coverage of the collection process during zero-gravity testing.

SEAT DESIGN

1. The seat design shall be adequate for use in one-g or zero-g environments.

2. The seat design shall be such that support will be provided for the ischial tuberosities of the crewmember.

3. The seat design shall allow access for wiping and still provide sealing to allow effective entrainment and contaminant control.

ODOR CONTROL

1. All air flow through the commode or urinal shall pass through odor control and bacteria filters prior to exit to the cabin.

2. An odor control filter composed of activated charcoal and Purafil shall be provided in the cabin exit line. It shall have a 30 day, 120 man-day capacity.

3. A bacteria filter shall be provided in the cabin exit line to remove bacteria in the air stream. It shall have a 30 day, 120 man-day capacity.

APPENDIX C

MINIMUM FLOW URINAL FEASIBILITY TEST
SUBJECTIVE DATA SHEET

MINIMUM FLOW URINAL FEASIBILITY TEST

SUBJECTIVE DATA SHEET

TEST SUBJECT _____ MALE _____

DATE _____ FEMALE _____

I. Positioning Jets:

A) Instructions: sit down, find comfortable position, and then use positioning jets.

B) Are the jets effective? YES _____ No _____

C) The jet pressure is:
too low _____
OK _____
too high _____

D) How much body adjustment was necessary when the jets were used?

very little (less than 1/2")
moderate (1/2" to 1")
considerable (greater than 1")

II. Urinal:

A) I have used the urinal:

never _____
once _____
twice _____
3 - 4 times _____
5 or more times _____

B) In my normal seated position for urination:

1) My knees are:

together
1, 2, 3, 4 fingers apart (circle one)
greater than 4 fingers _____

2) My thighs, over the front edge of the urinal, are:

together
1, 2, 3, 4 fingers apart (circle one).
greater than 4 fingers _____

C) The physical size of the urinal appears to be:

1) Too small to be an effective target (so small I don't even want to try it) _____

2) Slightly small (I have some res vations) _____

3) Adequate size _____

4) Larger than necessary (I could use a smaller urinal) _____

D) During my use, the urination felt:

normal _____
somewhat inhibited _____
definitely inhibited _____

E) Results:

1) The urinal collected all my urine. _____
2) The urinal collected all but a few drops. _____
3) The urinal was not able to collect a large portion of my urine (more than 10 drops) _____
4) This spillage went over the:

front _____
back _____ of the urinal.
sides _____

5) This spillage occurred at the:

beginning _____
middle _____
end _____ of my urination.
not sure _____

F) Conclusions:

1) The urinal is of adequate size. _____
2) The urinal should be wider. _____
3) The urinal should be longer. (front to back) _____
4) The urinal could be narrower. _____
5) The urinal could be shorter. (front to back) _____
6) The urinal should contour more to the body in:

front _____
sides _____
back _____

General Comments:

APPENDIX D

NONMETALLIC MATERIALS MASTER LOG

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
(CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

MLN

SUBSYSTEM: WCS
DATE: 11-27-73
REVISION: N/C
CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: SOLENOID VALVES
ITEM NO.: 340, 341, 345, 410 & 506
REQUESTING ORGANIZATION: WCS HSD
DRAWING NO. / CHANGE LETTER: MODEL EZ15 & EZ62, MFG.: ASCO
ORIGINATOR: A. Bach
REQUESTORS MAT'LS APPROVAL
SUBSYSTEM MANAGER (OR DESIGNEE)
CHAIRMAN

LINE NO.	VENDOR SUGGEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		SEALS			BUNA N			<.1	<60				
2		SOLENOID COATING	EPOXY		HYSOL MG-6 EPOXY			<.1	<50*				+ ENCLOSED IN EXPLOSION PROOF HOUSING
3		SOLENOID BOBBIN	NYLON		NYLON			<.1	0*				* ENCAPSOLATED BY EPOXY COATING, SEE #2
4		SOLENOID LUBRICANT		HUMBLE OIL	NEBULA EPR GREASE			<.01	<1				
5		WIRE INSULATION	POLYVINYL CHLORIDE		PVC			<.05	<15@				@ COVERED WITH TFE SPIRAL-WRAP AT ASSY LEVEL.
6		POTTING	SILICONE		RTV 102 SILICONE			<.1	<2.5				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
(CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

MLN

PAGE 1 OF 1

SUBSYSTEM: WCS
DATE: 12-11-1973
REVISION: N/C
COMPONENT PACKAGE: SPECSURE REGULATOR
ITEM NO.: 460 # 506
REQUESTING ORGANIZATION: WCS/HSL
DRAWING NO.: SK 4-10XT-1014 MFG: CONSFLOW
CHANGE LETTER:
ORIGINATOR: A Boehm
REQUESTERS MAT'LS APPROVAL:
SUBSYSTEM MANAGER (OR DESIGNEE): J. E. Lunden

CSD MRB APPROVAL (Concurrence)

CHAIRMAN

LINE NO	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		DIAPHRAM			BUNA-N			<.02	<6				
2		DIAPHRAM SUPPORT	TFE		TEFLON			<.02	<10				
3		END CAP			BLACK BAKELITE			<.2	<10				
4		SIGHT CRYSTAL	GLASS		GLASS			<.1	<7				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

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CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
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NONMETALLIC MATERIALS MASTER LOG

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SUBSYSTEM: WCS

DATE: 10-22-73 REVISION:

COMPONENT PACKAGE: EQU. CENTRIFUGAL ITEM NO.: 330

REQUESTING ORGANIZATION: WCS/H&D

DRAWING NO.: 7[illegible]Z5AA CHANGE LETTER:

ORIGINATOR: A Boe

REQUEST FOR MRB APPROVAL

SUBSYSTEM MANAGER (OR DESIGNEE)

CSD MRB APPROVAL (Concurrence)

CHAIRMAN

LINE NO.	MATERIAL REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	COND ACPT	REJ	REMARKS OR RECOMMENDATIONS
1		LOOP CLAMP	POLYAMIDE		NYLON			<.1	<1				
2		GROMMET	CHLOROPRENE POLYMER		NEOPRENE			<.1	<1				
3		SCREWS, SELF LOCKING INSERT			NYLON			<.1	0				
4		INSULATING TAPE	EPOXY/GLASS	PITTSBURG ELECT. INSUL. CO.	POLYGLAS BANDING TAPE			<.1	<1				
5		BEARING GREASE		GREASE PER MIL-G-3278	BEACON #325			<.1	<1				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

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SUBSYSTEM: WCS	DATE: 10-23-72	REVISION	CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: FAN, CENTRIFUGAL	ITEM NO.: 330	REQUESTING ORGANIZATION: WCS I-C D	
DRAWING NO.: P/N 1112584	CHANGE LETTER	ORIGINATOR: R. Fecher	
REQUESTORS MATLS APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE)	CHAIRMAN

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		STATOR END LAMINATION & SLOT WEDGE	EPOXY LAMINATED FIBERGLASS	NEMA G-10, PER MIL-P-18177 TYPE GEE				<.2	*				
2		INSULATING SLEEVING	SILICONE	BENTLEY HARRIS	BEN-HAR 1258-2			<.1	*				
3		INSULATING TAPE	POLYESTER FILM	3M	TAPE NO. 56			<.01	*				
4		LACING TAPE	EPOXY / GLASS	PITTSBURG ELECT. INSUL. CO.	POLYGLAS BANDING TAPE			<.1	*				
5		INSULATING VARNISH		MIL-V-1137A, TYPE M, GRADE CB				<.1	K10				ALL * MATLS COMPLETELY ENCAPSULATED BY VARNISH
6		INSULATING ENAMEL	ALKYD	GE	GLYPTAL #1201			<.1	<20				
7		LEADS WIRE INSULATION	TFE	MIL-W-16878D TYPE E	TEFLON			<.1	<5				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD (CSD/MRB)
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SUBSYSTEM: LSS
DATE: 10-22-12
REVISION:
CSD MRB APPROVAL (Concurrence):
COMPONENT PART NAME: CO2 VALVES
ITEM NO.: 615920
REQUESTING ORGANIZATION: HOD LSS
DRAWING NO.: 1-[illegible]-464-1 ; MFG: DUPRO CO.
CHANGE LETTER:
ORIGINATOR: A. Lee
SUBSYSTEM MANAGER (OR DESIGNEE):
CHAIRMAN:

USE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
		SEAL			BUNA-N			<.01	<2				

MSS COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
(CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

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SUBSYSTEM: ARC

DATE: 10 23 13 | REVISION:

COMPONENT PACKAGE: ETEC SDOR | ITEM NO.: 320 | REQUESTING ORGANIZATION: WCC / [illegible]

DRAWING NO.: SK BC480 | CHANGE LETTER: [illegible] | ORIGINATOR: [illegible]

REQUESTORS MAT'LS APPROVAL | SUBSYSTEM MANAGER (OR DESIGNEE): [signature]

CSD MRB APPROVAL (Concurrence) | CHAIRMAN

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSO-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
		FELT	TFE	GAF CORP TE2050 OR TE1029	TFE FELT			<.19	<175				
2		FACER	TFE	AMS 3654	TFE TUBING			<.02	<18				
3		CHARCOAL BED	ACTIVATED CHARCOAL	BARNEBEY CHENEY	TYPE AC COCONUT SHELL			<1.1	*				
4		SIEVE BED	ALUMINA SUBSTRATE KMNO4 IMPREG.	H.E. BURROUGHS	PURAFIL			<9.0	*				* ALL N MTL EXPOSED
5		FILTER, DUST	GLASS FIBER	FRAM CORP	TYPE HD			<.05	<400				
6		ADHESIVE	SILICONE	GE	RTV 102			<.06	<.5				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

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NONMETALLIC MATERIALS MASTER LOG

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SUBSYSTEM: WCS	DATE: 10-22-73	REVISION	CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: EXCEZIA FILTER	ITEM NO.: 31D	REQUESTING ORGANIZATION: WCC/MSD	
DRAWING NO.: A JH-SVG ; MFG - FLANDERS	CHANGE LETTER	ORIGINATOR: [illegible]	
REQUESTERS MAT'L APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE)	CHAIRMAN

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN²)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		FILTER ELEMENT	GLASS WITH ORGANIC BINDER	FLANDERS	J-GLASS			<1.0	<3000				
2		SEPARATORS			ASBESTOS			<2.0	<5000				
3		SEALANT			GLASS PACKING			<.1	<5				
4		POTTING	SILICONE	GE	RTV102			<.1	<3				FILTER ASSEMBLY IS RATED AS INCOMBUSTIBLE BY MANUFACTURER

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

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CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
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SUBSYSTEM: WCS
DATE: 10-22-73
REVISION:
CSD MRB APPROVAL (Concurrence)
COMPONENT/PACKAGE: KITE PUMP
ITEM NO.: 610
REQUESTING ORGANIZATION: WCS/HSD
DRAWING NO.: SK 10-70-303 ; Mfg ; MICROPUMP CORP.
CHANGE LETTER:
ORIGINATOR: A Fiedler
REQUESTING MAT'LS APPROVAL:
SUBSYSTEM MANAGER (OR DESIGNEE):
CHAIRMAN:

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		O RINGS			BUNA-N			<.01	<1				
2		BALL	TFE		TEFLON			<.002	<.2				
3		MAGNET	BARIUM FERRITE		BARIUM FERRITE			<.1	<.6				
4		INSULATION, ELECT WIRE	TFE		TEFLON			<.01	<.5				
5		GEAR & BUSHING			DELRIN AF			<.01	<2				
6		GUIDE, PISTON & INSERT			DELRIN 500			<.01	<3				
7		SEAL			POLYPROPYLENE / CARBON BLACK			<.01	<1				
8		MOTOR			UNKNOWN *			*	*				* UNKNOWN AMOUNT OF NONMETALLICS USED IN METAL HOUSING.

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

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SUBSYSTEM: ECLSS	DATE: 11-27-73	REVISION	CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: 2 2A N DRYER	ITEM NO.: 140	REQUESTING ORGANIZATION: ECLSS/HSD	
DRAWING NO.: [illegible] CHANGE LETTER: MEG : MICRO PUMP 10R8		ORIGINATOR: A. SOEHNEL	
REQUESTORS MATERIALS APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE): [signature]	CHAIRMAN

LINE NO.	ANSWER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		MAGNET	BARIUM FERRITE		BARIUM FERRITE			<.1	5.6				
2		BUSHING & THRUST PLATE	TFE, 15% GLASS FILLED		15% GLASS FILLED TEFLON			<.01	<4				
3		INSERT & 2 SEALS	TFE		TEFLON			<.01	<1				
4		MOTOR			UNKNOWN*			*	*				* MOTOR NONMETALLICS & QUANTITIES UNKNOWN BUT ENCLOSED IN METAL HOUSING

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

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SUBSYSTEM: WCS	DATE: 10.31.73	REVISION	CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: COMMODE ASSY	ITEM NO.	REQUESTING ORGANIZATION: WCC / HSD	
DRAWING NO.: SYSK 55340	CHANGE LETTER: N/C	ORIGINATOR: C Eschm	
REQUESTED MAT'L APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE)	CHAIRMAN

LINE NO	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		ROLLERS, 2/1-4L TRACK	FILLED TFE	DIXON	RULON "J"			<.01	<3.5				
2		PLUNGER NOSE	NYLON		NYLON			<.001	<.3				
3		"O" RING SEAL	FLUOROELASTOMER		VITON			<.01	<3				
4		ANAL HOSE	SILICONE/GLASS FIBER LAMINATE	R.E. DARLING	SILICONE COATING WITH FIBRE GLASS MESH CORE			<.3	110				FIBER GLASS COMPLETELY ENCAPSOLATED BY SILICONE
5		MOUNTING PADS	SILICONE		SILICONE			<1	<16				
6		FLEX TUBING	POLYETHYLENE		POLY-FLO, POLYETHYLENE			<.1	<45				
7		'C' SEALS			RUNA-N			<OR	<35				
8		FOOT PLATFORM LOW-SKID COVER	VINYL		KORO SEAL VINYL			<5.0	<800				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD (CSD/MRB)
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SUBSYSTEM: WCS
DATE: 10-31-73
REVISION:
CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: SEAT
ITEM NO.: 220
REQUESTING ORGANIZATION: WCS/HSD
DRAWING NO.: SVSK 88333
CHANGE LETTER: N/C
ORIGINATOR: C Fox
REQUESTORS MAT'LS APPROVAL
SUBSYSTEM MANAGER (OR DESIGNEE): J E Lindsey Jr.
CHAIRMAN

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		SEAT	POLYOLEFIN	MIL-T-22748A	HIGH DENSITY POLYETHYLENE			59	320				
2		SEAT PLATE COATING (SVSK 88334-100)	TFE		NITUFF, TFE IMPREGNATED HARDCOAT			<.03	<300				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

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SUBSYSTEM: LSS	DATE: 10-31-73	REVISION	CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: PANEL ASSY	ITEM NO.: 230	REQUESTING ORGANIZATION: LSS/HSD	
DRAWING NO.: SSC RS332	CHANGE LETTER	ORIGINATOR: C Boe	CHAIRMAN
REQUESTORS MATLS APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE): J E Lowder	

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
		PANEL	EPOXY/GLASS LAMINATE	SNHS2367 TYPE 10	FIBER-GLASS			<1.5	<15				
2		COVER SEAL	TFE		TEFLON			<.5	<2.5				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

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SUBSYSTEM: LCS	DATE: 10-23-13	REVISION	CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: ELTE, ODOR	ITEM NO.: 320	REQUESTING ORGANIZATION: WCC / HSD	
DRAWING NO.: SLSC04480	CHANGE LETTER: N/C	ORIGINATOR: G Eschm	
REQUESTORS MAT'LS APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE)	CHAIRMAN

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		FELT	TFE	GAF CORP TE2050 OR TE1029	TFE FELT			<.19	<175				
2		SPACER	TFE	AMS 3654	TFE TUBING			<.02	<18				
3		CHARCOAL BED	ACTIVATED CHARCOAL	BARNEBEY CHENEY	TYPE AC COCONUT SHELL			<6.1	*				
4		PURAFIL BED	ALUMINA SUBSTRATE KMNO4 IMPREG.	H.E. BURROUGHS	PURAFIL			<9.0	*				* ALL NFTL EXPOSED
5		FILTER, DUST	GLASS FIBER	FRAM CORP	TYPE HD			<.05	<900				
6		ADHESIVE	SILICONE	GE	RTV 102			<.06	<.5				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
(CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

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SUBSYSTEM: LCS	DATE: 10-23-73	REVISION:	CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: WATER SEPARATOR	ITEM NO.: 290	REQUESTING ORGANIZATION: WCS/H50	
DRAWING NO.: SK BB335	CHANGE LETTER: N/C	ORIGINATOR: R. Backus	
REQUESTORS MAT LS APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE): [signature]	CHAIRMAN

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		"O" RING			BUNA-N			<.02	<5				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD (CSD/MRB) NONMETALLIC MATERIALS MASTER LOG

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SUBSYSTEM: WCS	DATE: 10-23-73	REVISION	CSD MRB APPROVAL (Concurrence)
CONTRACT PACKAGE: FILTER, 2, COARSE	ITEM NO.: 346	REQUESTING ORGANIZATION: WCS/HSD	
DRAWING NO.: SLSK55373-200	CHANGE LETTER: N/C	ORIGINATOR: A Boehm	
REQUESTED MAT'L APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE)	CHAIRMAN

LINE NO.	ANSWER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		"O" RING			BUNA-N			<.02	.06				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
(CSD/MRB)
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SUBSYSTEM: WCS	DATE: 10-24-73	REVISION	CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: F-ER #2, COARSE	ITEM NO.: 350	REQUESTING ORGANIZATION: WCS/HSD	
DRAWING NO.: SK 85373-100	CHANGE LETTER: N/C	ORIGINATOR: A Fischer	
REQUESTORS MAT'LS APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE)	CHAIRMAN

LINE NO.	ANVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		ADHESIVE	EPOXY	3M	EC2216 B/A			<.05	<1				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

REF MSC Form 1033 (Apr 72)

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CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD (CSD/MRB)
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SUBSYSTEM: WCS
DATE: 10-24-73
REVISION:
CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: SUIT STERILIZER
ITEM NO.: 430
REQUESTING ORGANIZATION: WCS/HSD
DRAWING NO.: 3092-C-707 (CHEMTRIC)
CHANGE LETTER
ORIGINATOR: A. Bosch
REQUESTORS MAT'LS APPROVAL
SUBSYSTEM MANAGER (OR DESIGNEE): [signature]
CHAIRMAN

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		"O" RING			BUNA-N			<.01	<2				
2		FILTER PAD	GLASS FIBER	DOW CORNING	PYREX WOOL			<.1	*				
3		BED, INERT	GLASS BEADS					<.3	*				
4		BED, STERILIZING	SILVER CHLORIDE GRANULES					<.3	*				ALL * MAT'LS HAVE A LARGE EXPOSED AREA TO WATER.

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
(CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

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SUBSYSTEM: UCS	DATE: 10-24-73	REVISION: N/C	CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: WASTE STORAGE TANK	ITEM NO.: 930	REQUESTING ORGANIZATION: UCS/HSD	
DRAWING NO.: SK-SR564	CHANGE LETTER: A	ORIGINATOR: A Boehm	
REQUESTORS MAT'L IS APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE)	CHAIRMAN

LINE NO	MATERIAL REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
		NO NON-METALLICS IN THIS COMPONENT.											

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

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CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
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NONMETALLIC MATERIALS MASTER LOG

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SUBSYSTEM: WCS
DATE: 10-24-73
REVISION:
CSD MRB APPROVAL (Concurrence)
CONTENTS PACKAGE: ELECT. CONTROLLER
ITEM NO.: 710
REQUESTING ORGANIZATION: WCS / HSD
DRAWING NO.:
CHANGE LETTER:
ORIGINATOR: A Bachus
REQUESTORS MATLS APPROVAL:
SUBSYSTEM MANAGER (OR DESIGNEE): J G Gunter
CHAIRMAN:

LINE NO	MANUFACTURER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
B		CONNECTORS, BENDIX		BENDIX MIL-R-3065	NEOPRENE			<.1	<2				
9		[illegible]	TFE	MIL-W-16878D TYPE E	TEFLON			<.1	150				
D		INSULATION, CRIMP LUGS	NYLON		NYLON			<.03	<25				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

REF MSC Form 1033 (Apr 72)

HSD-72

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
(CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

MLN

SUBSYSTEM: WCS
COMPONENT/PACKAGE: ELECTRICAL CONTROLLER
ITEM NO.: 710
DRAWING NO.: CHANGE LETTER
REQUESTORS MAT'L SS APPROVAL
DATE: 10-24-73
REVISION
REQUESTING ORGANIZATION: WCS/MCD
ORIGINATOR: A Bacon
SUBSYSTEM MANAGER (OR DESIGNEE)

CSD MRB APPROVAL (Concurrents)

CHAIRMAN

LINE NO.	ANALYSIS REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		RELAY, TIMED		Du Pont	NYLON			<.15	56				
2		RELAY, TIMED	POLYCARBONATE					<.1	28				
3		SOCKETS, RELAY	PHENOLIC					<.5	<40				
4		RELAY, TELEDYNE	EPOXY		STYCAST			<.2	<1				
5		RELAY, TELEDYNE	PHENOLIC					<.1	<6				
6		TERMINAL STRIPS	PHENOLIC					<.5	<50				
7		CIRCUIT BREAKERS	PHENOLIC					<1.0	<60				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
(CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

MLN

PAGE 1 OF 1

SUBSYSTEM: WCS	DATE: 10-25-73	REVISION	CSD MRB APPROVAL (Concurrence)
COMPONENT NOMENCLATURE: DISPLAY & CONTROL	ITEM NO.: 715	REQUESTING ORGANIZATION: WCS/HSD	
DRAWING NO.	CHANGE LETTER	ORIGINATOR: A Fiedler	
REQUESTORS MAT'L'S APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE): [signature]	CHAIRMAN

LINE NO.	PARAGRAPH OR SPEC SECT NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		INSULATION, WIRE	TFE		TEFLON			<.02	<2				
2		INSERT, ELECT. CONN		MIL-R-3065	NOEPRENE			<.1	<2				
3		SWITCH SEALERS			UNKNOWN PLASTIC			<.01	2.5				
4		LIGHT LENS			UNKNOWN PLASTIC			<.01	<2				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
(CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

MLM

PAGE 1 OF 1

SUBSYSTEM: UCC
DATE: 10-31-73
REVISION:
CSD MRB APPROVAL (Concurrence)

COMPONENT PACKAGE: TANK PKG
ITEM NO.:
REQUESTING ORGANIZATION: WCS / HSD

DRAWING NO.: SLSK 20339
CHANGE LETTER: A
ORIGINATOR:

REQUESTED MRB APPROVAL
SUBSYSTEM MANAGER (OR DESIGNEE)
CHAIRMAN

LINE NO	ASSY REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (INZ)	MRB DECISION ACPT	COND ACPT	REJ	REMARKS OR RECOMMENDATIONS
		TEE	TFE		TEFLON			<.01	<2				
		[illegible] FITTING											
2		O' SEALS			BUNA-N			<.02	<3				
3		INSULATION,	TFE		TEFLON			<.01	<3				
		ELECT WIRING											
-1		LACING, LIGHT	NYLON		NYLON			<01	<3				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD (CSD/MRB) NONMETALLIC MATERIALS MASTER LOG

MLN

PAGE 1 OF 1

SYSTEM: LCS

DATE: 12-20-12 REVISION:

CSD MRB APPROVAL (Concurrence)

EQUIPMENT PACKAGE: SUIT EQUIPMENT OLG ITEM NO.

REQUESTING ORGANIZATION: WCS / HSD

DRAWING NO.: SLSC 88336 CHANGE LETTER: A

ORIGINATOR: A Bachman

REQUIREMENT IS APPROVAL

SUBSYSTEM MANAGER (OR DESIGNEE)

CHAIRMAN

LINE NO.	COMPONENT NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		TAPE, [illegible]	TFE		TEFLON			<.02	<6				
2		CLAMP CUSHION	TFE		TEFLON			<.02	<8				
3		CLAMP CUSHION	SILICONE		SILICONE			<.01	<3				
4		"O" SEALS			BUNA-N			<.04	<10				
5		VERATION CALIPER			RUBBER, NATURAL			<.02	<2				
6		FLEX EXT			NEOPRENE			<1.0	175				
7		INSULATION, ELECT WIRING	TFE		TEFLON			<.5	450				
8		SPIRAL-WRAP ELECT HARNESS	TFE		TEFLON			<3.5	<2000				
9		GASKET	SILICONE		SILICONE			<.5	<6				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD
(CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

MLN

PAGE 2 OF 2

SUBSYSTEM: WCS	DATE: 1-2-79	REVISION:	CSD MRB APPROVAL (Concurrence)
COMPONENT PACKAGE: COLLECTOR	ITEM NO.: 250	REQUESTING ORGANIZATION: WCS/HSD	
DRAWING NO.: SVSK 88331	CHANGE LETTER: V-C	ORIGINATOR: [illegible]	
REQUESTOR'S MAT'LS APPROVAL:		SUBSYSTEM MANAGER (OR DESIGNEE): [illegible]	CHAIRMAN

LINE NO	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
COLLECTOR MOTOR:													
8		GREASE		BEACON	BEACON GREASE			<.1	*				
9		STATOR LAMINATION ADHESIVE			BONDMASTER CEMENT			<.01	*				
10		WIRE WRAP	TFE		TEFLON			<.01	*				
[illegible]		COATING			VARNISH			<.06	*				
12		INSULATION			NOMEX			<.05	*				
13		INSULATION, ELECTRICAL			POLY 2000			<.02	*				
–		GROMMET			RUBBER			<.001	*				
													* INFORMATION NOT PROVIDED BY VENDOR

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD (CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

MLN

SUBSYSTEM: LSS	DATE: 10-31-93	REVISION	CSD MRB APPROVAL (Concurrence)
COMPONENT/PACKAGE: COLLECTOR	ITEM NO.: 250	REQUESTING ORGANIZATION: LSS/HSD	
DRAWING NO.: [illegible]	CHANGE LETTER: N/C	ORIGINATOR: [illegible]	
REQUEST FOR MATERIALS APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE)	CHAIRMAN

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN²)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		O RINGS	FLUOROELASTOMER		VITON			<.2	<.5				
2		SEALS, SLIPPER	TFE		TEFLON			<.01	<.02				
3		COUPLING, MOTOR	NYLON		NYLON			<.2	<30				
4		ADHESIVE	EPOXY	3M	EC 2216 B/A			<.1	<6				
5		COATING, SPINNER	TFE		TEFLON			<.05	<150				
6		LUBRICANT, [illegible]			KRYTOX GREASE			<.02	<.1				
7		INSULATION, ELECT. WIRE	TFE		TEFLON			<.2	460				

MRB COMMENTS OF CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD (CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

MLN

PAGE 1 OF 1

SUBSYSTEM: WCS

DATE: 5-31-73 | REVISION:

CSD MRB APPROVAL (Concurrence)

COMPONENT PACKAGE: COLLECTOR VALVE | ITEM NO.: 260

REQUESTING ORGANIZATION: WCS/HSD

DRAWING NO.: SLC6B23-3 | CHANGE LETTER: A

ORIGINATOR: [illegible]

REQUESTS WAIVER APPROVAL

SUBSYSTEM MANAGER (OR DESIGNEE): [signature]

CHAIRMAN

LINE NO.	WAIVER REQUEST NUMBER	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		FIRST PAD & WASHER	FILLED TFE	DIXON	RULON "J"			<.01	<3				
2		BUSHING	FILLED TFE	DIXON	RULON "J"			<.03	<4				
3		"O" RING SEAL	FLUOROELASTOMER		VITON			<.01	<3				
4		FUNNEL NOSE	NYLON		NYLON			<.01	<5				
5		COATING	TFE		NITUFF, TFE IMPREGNATED HARDCOAT			<.001	<8				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

CREW SYSTEMS DIVISION SSP ETC/LSS MATERIALS REVIEW BOARD (CSD/MRB)
NONMETALLIC MATERIALS MASTER LOG

MLN

PAGE 1 OF 1

SUBSYSTEM: NCS	DATE: 12-31-73	REVISION	CSD MRB APPROVAL (Concurrence)
COMPONENT/PACKAGE: MANIFOLD	ITEM NO.: 210	REQUESTING ORGANIZATION: WCS/H2D	
DRAWING NO.: SVKE22330	CHANGE LETTER: A	ORIGINATOR: A. Fox	
REQUESTER'S MATLS APPROVAL		SUBSYSTEM MANAGER (OR DESIGNEE): [illegible]	CHAIRMAN

LINE NO.	MATERIAL REQUEST NO.	FIND OR ITEM NO. AND INTENDED MATERIAL USAGE	MATERIAL GENERIC NAME	MANUFACTURER AND MATERIAL SPECIFICATION	MANUFACTURER'S MATERIAL DESIGNATION	USAGE CATEGORY CSD-SS-012	USAGE ENVIRONMENT	APPROX WT (lbs)	APPROX EXP. AREA (IN2)	MRB DECISION ACPT	MRB DECISION COND ACPT	MRB DECISION REJ	REMARKS OR RECOMMENDATIONS
1		ADHESIVE	EPOXY	3M	EC 2216 B/A			<.01	<.2				
2		SEALANT, PIPE THREADS	TFE		TEFLON TAPE			<.01	<1				
3		COATING	TFE		NITUFF, TFE IMPREGNATED HARDCOAT			<.01	<32				

MRB COMMENTS OR CONDITIONS OF ACCEPTANCE

APPENDIX E

FUNCTIONAL TEST DATA SHEET

PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM
FUNCTIONAL TEST DATA SHEET

Test Subject_____Date_____Time_____

I. Positioning Jets:

A. Instructions: Sit down, find comfortable position, and then use positioning jets.

B. Are the jets effective? Yes_____No_____

C. The jet pressure is: Too low_____ OK_____ Too high_____

D. Was body adjustment necessary after jets were used? Yes_____No____. If yes how much? Very little (less than 1/2")_____ Moderate (1/2" to 1")_____ Greater than 1 inch_____

II. Urine Collection:

A. Was there any urine splashing or soiling outside of the urinal? Yes_____No_____. If yes, where? _____

B. Was your position proper for urination? Yes_____ No_____. If not, describe movement required to attain proper position. _____

_____

C. Was the seat comfortable for urination? Yes_____ No_____

D. Could you feel the urinal air flow? Yes_____ No_____, was it acceptable Yes____ No___

E. MALES

1) Was the urinal in the male position acceptable for usage? Yes_____No_____. If not, where would you locate the urinal for use? _____

F. FEMALES

1) In normal seated position how close is urinal to vulva area. More than 1/2 inch____ less than 1/2 inch, estimate amount_____

2) In normal seated position indicate knee position.together,
1, 2, 3, 4 fingers apart, or greater than 4 fingers (circle one)

3) Indicate thigh closure over front edge of urinal.together,
1, 2, 3, 4 fingers apart or greater than 4 fingers (circle one)

4) Was there adequate wipe access? Yes_____ No_____. Indicate the number of wipes used for vulva wiping_____.

III. Fecel Collection:

A. Was your position proper for defecation? Yes_____No_____, if not describe movement needed for proper position_____

_____

B. Was the seat comfortable? Yes_____No_____

C. Could you feel the commode airflow? Yes_____No_____

Was it acceptable? Yes_____No_____

D. Was there soiling on the seat, transfer duct or any other unusual area? Yes___No___. If yes, describe where and how much. _____

_____

E. How many wipes did you use?_____. Was there adequate access for wiping and wipe disposal? Yes_____No_____.

IV. List any other comments you consider pertinent.

APPENDIX F

PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM ZERO-GRAVITY TEST PROCEDURE

PRELIMINARY FLIGHT PROTOTYPE

WASTE COLLECTION SUBSYSTEM

ZERO-GRAVITY TEST PROCEDURE

PREPARED UNDER CONTRACT NAS 9-12938

by

HAMILTON STANDARD

DIVISION OF UNITED AIRCRAFT CORPORATION

WINDSOR LOCKS, CONNECTICUT

for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LYNDON B. JOHNSON SPACE CENTER

HOUSTON, TEXAS 77058

DECEMBER, 1973

Prepared by: J. E. Swider, Jr.
Program Engineer

Approved by: F. H. Greenwood
Program Manager

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1.0 INTRODUCTION

The purpose of this test procedure is to define in detail the objectives, data requirements, test equipment and test profiles that will be utilized to perform zero-gravity testing of the Preliminary Flight Prototype Waste Collection Subsystem developed under contract NAS 9-12938. The zero-gravity testing will be conducted on the NASA zero-gravity test aircraft operated from Ellington Air Force Base.

The test fixtures, two test operator/monitors (who will also act as male test subjects) and the required data reduction capability will be provided by Hamilton Standard. The zero-gravity airplane, flight crew, photographic support, film and film processing, and qualified female test volunteers will be Government Furnished Property.

2.0 TEST OBJECTIVES

The following are the test objectives for this test program:

A. Evaluate the ability of the low flow urinal developed under contract NAS 9-12938 to collect urine from both females and males under zero-gravity conditions.

B. Determine the feces collection capability of the commode developed under contract NAS 9-12938 under zero-gravity conditions and establish the best equipment/entrainment air flow configuration.

C. Determine the comfort and functional suitability of the seat configuration utilized in the Preliminary Flight Prototype Waste Collection Subsystem.

D. Determine the overall functional usability of the Preliminary Flight Prototype Waste Collection Subsystem in the zero-gravity environment from a human factors and maintenance standpoint.

3.0 TEST SEQUENCES

3.1 Evaluate Female/Male Urine Collection

This test series will involve the use of both male and female test volunteers. The objective of these tests will be to verify the ability of the NAS 9-12938 urinal to collect urine from both male and female test volunteers in a zero-gravity environment.

3.1.1 Test Equipment

The test equipment to be utilized in this test program consists of the Preliminary Flight Prototype Waste Collection Subsystem developed under contract NAS 9-12938 and a liquid supply package constructed for the zero-gravity test program. The waste collection subsystem with the liquid supply package is depicted schematically in figure 3-1. In addition, Table 3-1 contains a list of components provided in the test fixture.

The basic waste collection subsystem consists of a commode assembly, a support equipment package and a tank package. The commode assembly is the waste collector and consists of the feces and urine collection portions. The feces collection portion, consisting of the collector valve, slinger and feces storage container, interfaces with the seat via the fecal transfer duct. The fecal transfer duct contains the fecal collection air entrainment nozzles and the user positioning jets. The urine collection portion consists of a movable non-intimate contact urinal that uses a primary and an induced rear air entrainment flow for collecting urine and contains an internal flush capability. For the zero-gravity tests a foot platform with foot restraints will be provided and a lap belt will also be incorporated on the commode assembly.

The support equipment package contains all auxilliary equipment required to operate the commode assembly. Air entrainment flow is provided by a single centrifugal fan for both urine and feces collection. Flow from the urinal passes through a debris filter and a liquid/air separator (identical in design to a liquid/air separator previously zero-gravity tested). The liquid is pumped from the separator to the tank package while the air flow continues through the fan and is exited into the test area via a bacteria and odor control filter. The feces collection air entrainment flow is drawn through the ducts in the fecal transfer duct and through the commode by the fan and is exited into the test area through the bacteria and odor filter. Also contained in the commode flow loop are

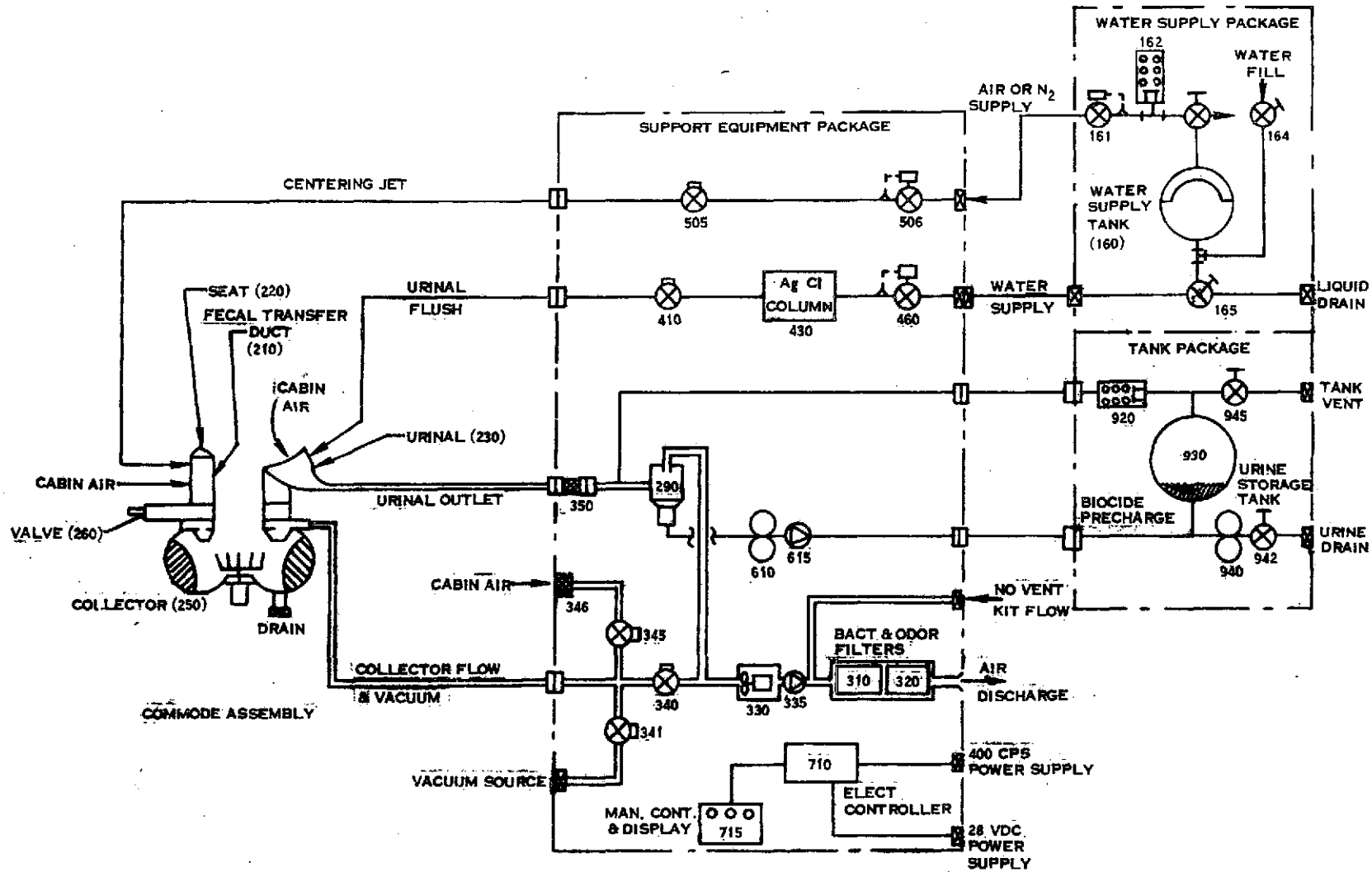


FIGURE 3–1 PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM ZERO-GRAVITY TEST EQUIPMENT SCHEMATIC

TABLE 3-1 PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM ZERO-GRAVITY TESTS COMPONENT PARTS LIST

Item Number	Component	Description
	Commode Assembly	SVSK 88340
250	Collector	Aluminum construction, SVSK 77762 & SVSK 88331
260	Collector Valve	Rotating gate, aluminum construction, SVSK 88313
230	Urinal	Fiberglass construction, SVSK 88332
210	Manifold	Aluminum construction, SVSK 88330
220	Commode Seat	Polyethylene construction, SVSK 88333
	Support Equipment Package	Welded aluminum structure SVSK 88336
290	Water Separator, Vortex	Stainless steel construction, SVSK 88335
310	Bacteria Filter	Flanders filter, absolute filter #JH33-g
320	Odor Filter	Charcoal and purafil, SVSK 84480
330	Fan	Dynamic Air P/N M125AA, 400 Hz 3 ø 200 VAC
335	Check Valve	Technocheck check valve
340	Collector Flow Valve	ASCO P/N 8215A81UM 28VDC solenoid
341	Vacuum Valve	ASCO P/N 821524UM 28VDC solenoid
345	Equalization Valve	ASCO P/N 8215B21UM 28 VDC solenoid
346	Debris Filter	SVSK 88373 stainless screen construction
350	Debris Filter	SVSK 88373 stainless screen construction
410	Flush Valve	ASCO P/N 8262A221 28 VDC solenoid
430	Silver Chloride Column	Chemtric P/N 3197-C-702, stainless steel construction
460	Water Pressure Regulator	Conoflow P/N H-1017-1014
505	Positioning Jet Valve	ASCO P/N 8262A221 28 VDC solenoid
506	Gas Pressure Regulator	Conoflow P/N PH05
610	Urine Pump	Micro-Pump 09-70-3.3(66805), 400 Hz, 3ø, 200 VAC
620	Check Valve	Nupro P/N SS-4C4-1
710	Controller	Contains 5 P&B relays & 3 teledyne relays, a 200 VAC 3 ø 400 Hz 20 amp circuit breaker and a 28 VDC 10 & circuit breaker and miscellaneous connecting wiring.
715	Manual Control Box	Contains 3 Licon 01-365530 switches and 3 Dialight 101-5030-0972-21 lights
	Tank Package	Welded construction, SVSK 88339
920	Relief Valve	Nupro P/N SS-4C4-1
930	Urine Storage Tank	Stainless steel P/N SVSK 88364
940	Drain Pump	Micropump P/N 10-70-316 400 Hz 3ø 200 VAC

TABLE 3-1 PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM ZERO-GRAVITY TESTS COMPONENT PARTS LIST (CONCLUDED)

Item Number	Component	Description
942	Drain Valve	Whitey P/N 45F8-316
945	Vent Valve	Whitey P/N 45F8-316
	Water Supply Package	Unistrut construction
160	Water Supply Tank	Greer Olean #275K-5-WS-5 bladder tank
161	Gas Pressure Regulator	Conoflow PH05
162	Relief Valve	Nupro SS-4CPAZ-3-DC
163	Vent Valve	Whitey 43xS4-316
164	Tank Fill Valve	Whitey 44S6-316
165	Feed & Drain Valve	Whitey 43xS6-316

3.1.1 (Continued)

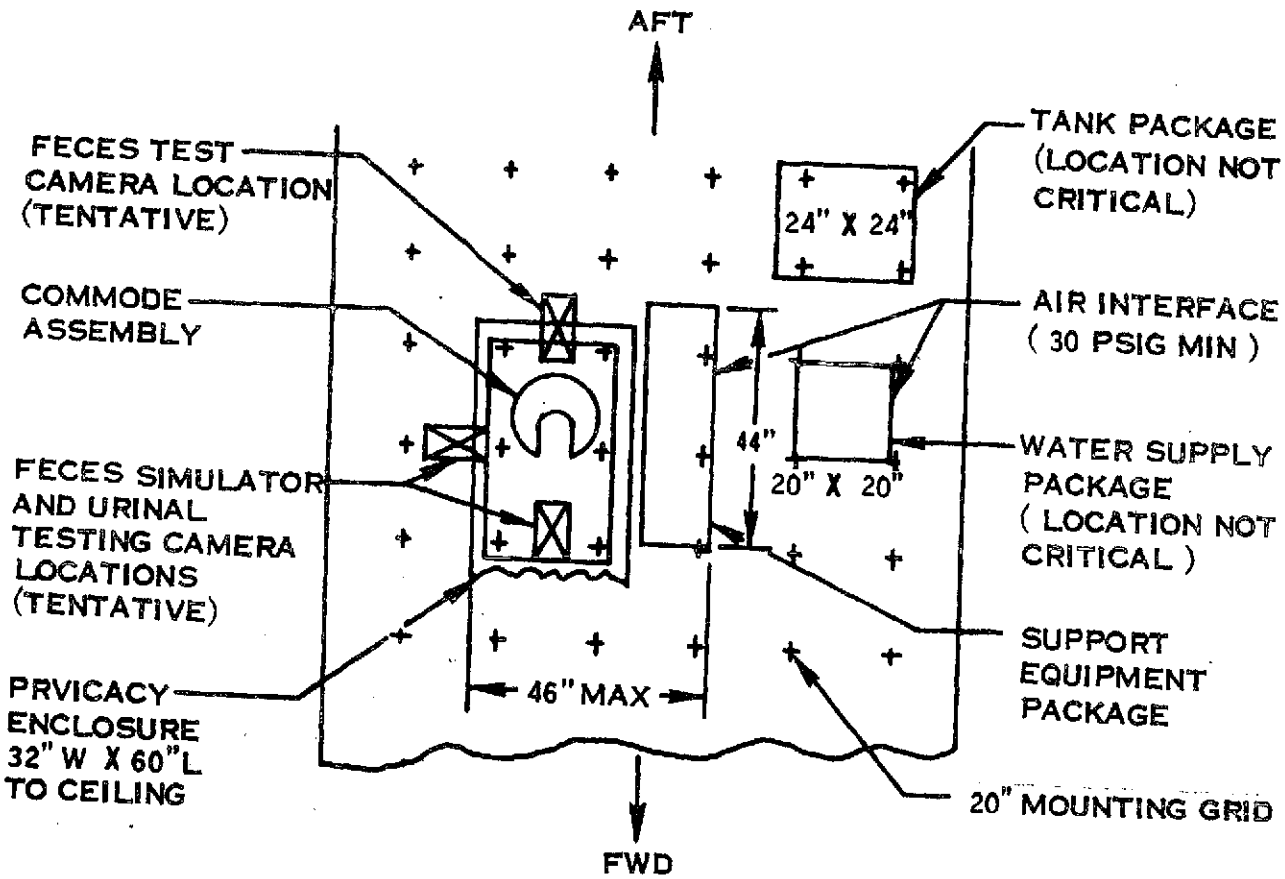
the proper valves to allow vacuum drying of the feces when desired. It should be pointed out that no vacuum drying of the feces will be accomplished during this test program. The support equipment package also contains manually adjustable pressure regulators and solenoid valves in the urinal flush and positioning jet loops to control the liquid and gas pressure and actuation in these loops. The urinal flush loop also contains a silver chloride column to add a biocidal agent to the urinal flush water.

The controls required to operate the WCS are also contained in the support equipment package. An electrical controller contains all the relays and timers required to operate and sequence all components properly; also contained are circuit breakers for both the 400 Hz AC circuit and the 28 VDC circuit. A movable control box with three switches operates the system. One switch turns on the system, another switch shuts down the system and the third switch operates the user positioning jets. Lights on the control box indicate the various operating modes.

The tank package collects the urine and flush water from the system; it includes a 30-gallon capacity tank and has a pump to allow draining of the tank. It draws its power from the support equipment package.

Since water for the WCS is generally provided by the test facility, a special water supply package has been made up for use on the test aircraft. This package consists of a bladder tank with a five-gallon capacity, a gas regulator to control pressure to the bladder and the proper valves and plumbing to fill and empty the package. This package only requires a gas source for operation on the test aircraft and the same source used for the user positioning jets may be utilized.

In addition, a privacy enclosure that was used for previous waste management testing aboard the zero-gravity aircraft will be used during this test series. The various packages are constructed of either welded or bolted "Unistrut" components and bolt to the aircraft via the 20-inch mounting grids. The commode assembly is bolted to a 1/4-inch steel plate that has holes to allow mating to the 20-inch mounting grid. A layout of the equipment is shown in figure 3-2.



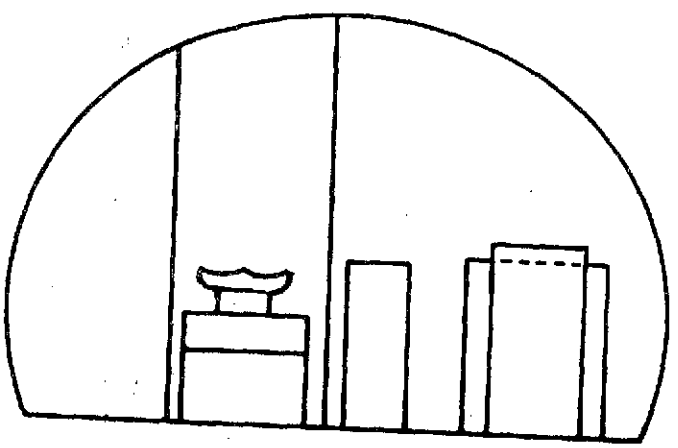


FIGURE 3–2 WCS ZERO–GRAVITY TEST EQUIPMENT LAYOUT

3.1.2 Test Sequences

Initially the WCS will be set up to operate at the urinal design flow conditions of 10 scfm primary flow drawn between the users thighs and 5 scfm rear flow. To fully demonstrate the collection capability of the urinal 20 to 24 successful collections of female micturitions and 4 to 6 successful male collections will be accomplished at the design conditions.

Should collection prove unsuccessful at the design conditions, the urinal flow will be increased by blocking the feces air entrainment flow. This will increase the primary flow to 17 scfm and the backflow to 8 scfm. An evaluation of collection capability at these conditions will be made by the test conductors. While the evaluation of urinal testing is being made (if necessary) the testing will continue on the feces collection portion of the program. If flight time exists in the test program after feces collection tests are completed and the NASA concurs, modifications to the test fixture could be made and additional urinal testing conducted.

3.1.3 Test Procedure

The test procedure to be followed during the subjective test portions of this program will be the same as utilized in previous waste management testing under this contract. The test volunteers will enter the privacy enclosure and prepare for testing. They will sit on the WCS and put the urinal in the proper position, male or female; once the urinal is positioned they will use the positioning jets to attain the proper position and set themselves positively using the lap belt and foot restraints. They will be in contact with the test conductor and other aircraft personnel by intercom. Once the test volunteer is prepared, the test conductor will activate the WCS and a series of six zero-gravity maneuvers will flown. During these maneuvers any photographic coverage will be automatically controlled by the flight engineer. At the completion of six maneuvers, the test volunteers will be changed (even if micturition has not been accomplished). This procedure will continue until all test volunteers on the flight have had their opportunity to utilize the WCS. It is anticipated that this portion of the testing will require a maximum of 240 maneuvers in five flights to meet the test objectives.

3.1.4 Data Requirements

Table 3-2 presents the flight test data work sheet that will be utilized by the test conductor to plan and document each test performed. The data sheet contains room to record all pertinent information. While the test conductor will not have any direct visual observations to record, any pertinent comments will be noted. In addition, each test point will be recorded by movie cameras located to the side and front of the urinal as shown in figure 3-2. Also, each test volunteer will fill in the test data sheet presented in Table 3-3 after completion of a series of test points.

3.2 Evaluate Preliminary Flight Prototype WCS Feces Collection Capability

This test sequence will be carried out in two distinct portions. One portion will utilize a feces simulator to check out the basic operation of the commode feces entrainment air flow. The other portion will involve the use of the same volunteers utilized during the urinal testing for feces collection tests. The simulator testing will be accomplished initially.

3.2.1 Feces Simulator Testing

The feces simulator testing will be conducted initially to gain experience of the feces collection characteristics of the Preliminary Flight Prototype WCS prior to subjective testing. The simulator will be utilized to test the performance of the commode design and air entrainment flows developed under contract NAS 9-12938 and to optimize this design.

3.2.1.1 Test Equipment

The test equipment used during this test sequence will be the same as utilized during the urinal testing with the exception of the feces simulator. The feces simulator is made from a commercial air-powered caulking gun. The caulking gun will be mounted to a plexi-glass fixture capable of being secured to the commode seat. The fixture will fit the contour of the seat as a test subject would. The caulking gun will be powered by the same pressure source utilized by the user positioning jets and the bladder tank in the water supply module.

A mixture of dog food and peanut butter will be utilized to create the simulated feces. This mixture will be made up in various consistencies and preloaded into commercial caulking

TABLE 3–2 URINAL FLIGHT TEST DATA / WORK SHEET

DATE ________

SHEET ____ OF ____

TEST CONDITIONS				
PARABOLA NO.	RUN NO.	TEST SUBJECT	URINAL AIRFLOW CONDITIONS	TEST CONDUCTORS REMARKS / OBSERVATIONS

TABLE 3-3 URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. _____

Date _____ Data Sheet No. _____ Run No. _____

Subject Comments

a) Was micturition accomplished? Yes _____ No _____.

b) Did the urinal collect the total micturition? Yes _____ No _____.

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No _____. If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No _____. If yes, estimate quantity and describe location and pattern of splash.

e) Was the airflow noticeable? Yes _____ No _____.

Comfortable? Yes _____ No _____.

f) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No _____. If yes, explain _____.

g) Was the seat comfortable and acceptable for use during collection? Yes _____ No _____. Describe/explain _____.

h) Was the positioning jet effective in locating you for use of the system? Yes _____ No _____. Describe/explain if any problems _____.

i) Were the provided restraint devices effective during collection? Yes _____ No _____. What restraint devices were used during zero-gravity collection? foot___; lap belt___; hand___; combination_____.

j) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent.

3.2.1.1 (Continued)

containers. The use of the automatic caulking gun and several preloaded containers will allow the gaining of more useful information per flight and also allow better utilization of the flights.

3.2.1.2 Test Sequences

Initially the WCS will be set up to operate at the commode air entrainment flow design point condition of 20 scfm. At this condition several types of simulated boli ranging from consistencies of very loose to very hard and of several different shapes and sizes will be injected into the fecal transfer duct by the simulator. It is estimated that between 20 and 30 different boli will be used in combination with various rates of injection.

If collection is successful at the design point condition using the simulator, then subjective testing will begin. If the testing at the design point is not considered adequate then the entrainment flow will be increased to 30 scfm, the maximum capability of the system, and the tests repeated. If there is some question at this point to the usability of the system, a decision will be made by the test conductors whether additional simulator tests are required or whether subjective testing can be initiated.

3.2.1.3 Test Procedure

For the feces simulator tests the simulator will be mounted on the commode prior to flight initiation. Once the test area has been reached and test conditions established, one of the caulking tubes will be loaded into the gun. When the zero-gravity portion of the maneuver is reached the gun will be activated and the contents of the tube evacuated into the commode. Cameras will be set up strategically to record this as will the test conductor. At the completion of the maneuver the spent tube will be removed and a new tube installed. It is not known at this time whether continuous maneuvers may be flown or whether loading the tubes will require an interruption; this will require determination in the aircraft. The flight will continue until all tubes are expended. Between injections of the simulated feces the test conductors will also throw in portions of tissue wipes with the feces trying to simulate actual usage in the internal distribution within the commode.

3.2.1.3 (Continued)

At the completion of the flight the commode will be opened up by the test conductors and the internal distribution of the feces and wipes inspected to determine the effectiveness of the slinger and wipe retention method. After inspection the commode will be cleaned using the cleaning port in the bottom and prepared for the next day's test.

It is anticipated that this portion of the test program will require two flights with a total of 60 to 80 maneuvers to check out the design point. If testing is unsuccessful at the design point the amount will double to four flights and 120 to 160 maneuvers.

3.2.1.4 Data Requirements

The test conductors will utilize the data work sheet presented in Table 3-4 to record the pertinent test data. The test conductors will record the direct visual comments with respect to the effectiveness of the air entrainment flow, type of motion of the bolus, contact with the fecal transfer duct and any other information. In addition, the test conductor will also record on the day's data sheet the results of the commode internal inspection at the conclusion of the flight.

In addition, movie cameras will be utilized during the test to record each test point. It is not known at this time whether a fixed or hand-held camera or both will be required to adequately record the information. The internal commode condition after the flights will also be recorded photographically.

3.2.2 Evaluate Subjective Feces Collection

Testing will be conducted with the same test volunteers utilized during the urinal testing. The objective will be to verify that the commode configuration and air entrainment flow conditions established during the feces simulator tests are in fact suitable for subject use in zero-gravity.

3.2.2.1 Test Equipment

The subjective feces collection testing will be conducted utilizing the Preliminary Flight Prototype WCS depicted schematically in figure 3-1. The only difference between this test and the urinal testing in terms of equipment will be in

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TABLE 3-4 FECES SIMULATOR FLIGHT TEST DATA / WORK SHEET

DATE———

SHEET——— OF ———

PARABOLA NO.	COMMODE AIR FLOW	TUBE NO.	TUBE EXPULSION RATE	COLLECTED		BOLUS MOTION	WIPES DEPOSITED	TEST CONDUCTOR REMARKS / OBSERVATIONS
				YES	NO			

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3.2.2.1 (Continued)

the number of cameras utilized to record data; it is anticipated that only one movie camera will be required for the feces collection tests. The location of this camera will be determined at the test site.

3.2.2.2 Test Sequences

The Preliminary Flight Prototype WCS will be set up to operate at the air entrainment flow rate deemed acceptable for collection by the results of the feces simulator tests. It is anticipated that this flow-rate will be 20 scfm. In any case whatever flow-rate is acceptable will be used. If the initial flow-rate is not found acceptable to the test volunteers then the flow-rate will be changed to another rate at the discretion of the test conductor. To verify the ability of the WCS to collect feces once an acceptable flow-rate is found, a minimum of five representative defecations will be needed to verify collection capability; it would be desirable to obtain 15 to 20 defecations if time permits.

3.2.2.3 Test Procedure

The test procedure to be utilized for the subjective feces collection tests will be the same as used for the urinal testing as described in paragraph 3.1.3 of this document. The only difference will be that once the defecation has been completed, the test volunteer will utilize wipes for post-elimination cleansing and will deposit the wipes into the commode during the zero-gravity portion of a maneuver.

At the completion of each day's flight, the test conductors will open the commode and note and record the feces and wipe distribution within the collector. After inspection the commode will be cleaned daily, using an in-place cleansing method.

It is not known how many test maneuvers or flights will be required to obtain the number of feces collections desired to verify the system's ability. For that reason this will be the last test sequence in the test program and will continue until the aircraft time allotted to WCS testing has all been utilized.

3.2.2.4 Data Requirements

The test conductor will utilize the data/work sheet presented in Table 3-5 to record the pertinent test data. The test conductors will not have any direct visual comments to record but will record any required information. Each test point will be recorded by a movie camera located within the privacy enclosure. The primary purpose of the camera will be to record the subject's position on the commode seat during the collection process. In addition, the test volunteers will fill in the test data sheet presented in Table 3-6 after completion of a series of test points.

Also, the results of the commode inspection after each day's test will be recorded on the flights data/work sheet.

3.3 Evaluation of the Commode Seat

The evaluation of the usability and suitability of the seat configuration utilized on the Preliminary Flight Prototype WCS will be conducted in conjunction with the collection tests. The primary input into the acceptability of the seat will be subjective comments with regard to comfort and functionability. The other area that will reveal the effectiveness of the seat design will be the photographic data that will be recorded showing subject position variance.

3.4 Evaluation of Functional Acceptability of the Preliminary Flight Prototype Waste Collection Subsystem

This portion of the test evaluation of the WCS will be concerned with the human factors and maintenance aspects of the WCS. The human factors evaluation will be highly dependent on subjective comments. The types of items that will be evaluated are acceptability of the collector valve motion, convenience of the movable urinal, ease of wipe disposal and general ease of operation.

The maintenance aspects of the WCS will be evaluated from the standpoint of pre- and post-flight activity required to maintain operation, the amount of unscheduled maintenance or repairs required and general ease of cleaning the unit.

Hamilton Standard
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TABLE 3-5 FECES COLLECTION FLIGHT DATA / WORK SHEET

DATE ________

SHEET ____ OF ____

PARABOLA NO	RUN NO	TEST SUBJECT	COMMODE AIRFLOW CONDITIONS	TEST CONDUCTORS REMARKS / OBSERVATIONS

TABLE 3-6 FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject:

Date _____ Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No _____.

Was micturition accomplished? Yes _____ No _____.

b) Did the commode collect the bolus ? Yes _____ No _____.

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____.

d) Did you feel uncomfortable like the bolus was smearing you?

Yes _____ No _____.

e) Could you determine if you were abnormally soiled?

Yes _____ No _____. If yes, how much? _____

f) Could you feel the airflow? Yes _____ No _____.

Was it acceptable? Yes _____ No _____.

g) Was there adequate wipe access? Yes _____ No _____.

h) How many wipes did you use? _____.

i) Was the positioning jet effective in locating you for use of the commode? Yes _____ No _____ Explain _____.

j) Was the seat comfortable and acceptable for use during collection?

Yes _____ No _____. Describe/explain _____.

k) Were the restraint devices effective during collection?

Yes _____ No _____.

l) List any other general comments on the performance of the system during zero-gravity that you feel are pertinent.

APPENDIX G

PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM ZERO-GRAVITY TEST SUBJECTIVE DATA SHEETS

PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM

ZERO GRAVITY TEST SUBJECT HEIGHTS AND WEIGHTS

Test Subject	Height	Weight
Female #1	1.65 m (65 in.)	63.5 kg (140 lbs)
Female #2	1.63 m (64 in.)	61.2 kg (135 lbs)
Female #3	1.75 m (69 in.)	65.7 kg (145 lbs)
Female #4	1.68 m (66 in.)	63.5 kg (140 lbs)
Female #5	1.66 m (65.5 in.)	61.2 kg (135 lbs)
Female #6	1.65 m (65 in.)	59.9 kg (132 lbs)
Female #7	1.60 m (63 in.)	589.9 kg (130 lbs)
Female #8	1.75 m (69 in.)	70.7 kg (156 lbs)
Female #9	1.73 m (68 in.)	70.3 kg (155 lbs)
Female #10	1.59 m (62.5 in.)	47.6 kg (105 lbs)
Female #11	1.66 m (65.5 in.)	61.2 kg (135 lbs)
Female #12	1.74 m (68.5 in.)	64.4 kg (142 lbs)
Female #13	1.66 m (65.5 in.)	59.9 kg (132 lbs)
Male #1	1.96 m (77 in.)	111.1 kg (245 lbs)
Male #2	1.88 m (74 in.)	93.0 kg (205 lbs)
Male #3	1.82 m (71.5 in.)	79.4 kg (175 lbs)

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 2

Date 28 Jan 74 Data Sheet No. 1 Run No. 1

Subject Comments:

a) Was micturition accomplished? Yes X No ____

b) Did the urinal collect the total micturition? Yes X No ____

c) Was there any pooling of fluid in the pubic area during collection? Yes ____ No X If yes, estimate quantity and describe location and pattern of contamination.

d) Was there any backsplash onto yourself or the seat area during collection? Yes ____ No X If yes, estimate quantity and describe location and pattern of splash.

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes X No ____
Comfortable? Yes X No ____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes ____ No X If yes, explain

h) Was the seat comfortable and acceptable for use during collection? Yes X No ____ Describe/explain

i) Was the positioning jet effective in locating you for use of the system? Yes X No ____ Describe/explain if any problems

j) Were the provided restraint devices effective during collection? Yes X No ____ What restraint devices were used during zero-gravity collection? foot and lap belt X hand X

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent.

NOTE: TESTING ON 1/28 TO 2/5 RESULTED IN MANY COMMENTS OF COLD AIR, THIS WAS CAUSED BY LACK OF HEAT IN THE AIRCRAFT, SYSTEM USES AMBIENT AIR.

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 6

Date 28 JAN 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of splash. _____

e) How many vaginal wipes were used? 2

f) Was the airflow noticeable? Yes ✓ No _____
Comfortable? Yes _____ No ✓ slightly cold

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

felt as if the urine went into back container not the urinal

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 7

Date 5 JUN 74 Data Sheet No. _____ Run No. 01

Subject Comments:

a) Was micturition accomplished? Yes ✓ No ____

b) Did the urinal collect the total micturition? Yes ____ No ____

c) Was there any pooling of fluid in the pubic area during collection? Yes ✓ No ____ If yes, estimate quantity and describe location and pattern of contamination. Not really know if witness any pooling or splashing or backflow, but definite (cont'd)

d) Was there any backsplash onto yourself or the seat area during collection? Yes ✓ No ____ If yes, estimate quantity and describe location and pattern of splash. (continued) wetness noted in perineal area, (cont'd) trace rear.

e) How many vaginal wipes were used? one

f) Was the airflow noticeable? Yes ✓ No ____
Comfortable? Yes ____ No ✓ Cold !!!

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes ____ No ✓ If yes, explain ____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No ____ Describe/explain Seemed quite natural.

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No ____ Describe/explain if any problems ____

j) Were the provided restraint devices effective during collection? Yes ✓ No ____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. ____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 3
Date 28 JAN 73 Data Sheet No. 1 Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of splash. _____

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes ✓ No _____
Comfortable? Yes ✓ No _____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No.

Date 4 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of splash. _____

e) How many vaginal wipes were used? 1 it wasn't very wet.

f) Was the airflow noticeable? Yes ✓ No _____
Comfortable? Yes _____ No ✓

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent.
The air flow was so cold that it caused an aching sensation around the anus.

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 3

Date 1/25/74 Data Sheet No. _____ Run No. 1

Subject Comments:

a) Was micturition accomplished? Yes X No _____

b) Did the urinal collect the total micturition? Yes _____ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No X If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes X No _____ If yes, estimate quantity and describe location and pattern of splash. Couldn't tell ain't but it felt as if urine was running backward over and area

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes X No _____ Comfortable? Yes _____ No X too cold - felt like sitting on ice

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes X No _____ Describe/explain if any problems It feels slightly too wide in the area it covers - could be concentrated smaller jet

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt X hand X

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

NOTE: DUE TO INCLEMENCY OF THIS SHEET THE GENERAL COMMENTS ARE TO BE FOUND ON THE FOLLOWING PAGE

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No.

Date _____ Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes _____ No _____

b) Did the urinal collect the total micturition? Yes _____ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No _____ If yes, estimate quantity and describe location and pattern of contamination. See later explanation

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No _____ If yes, estimate quantity and describe location and pattern of splash. See later explanation It did not cover to get down far enough

e) How many vaginal wipes were used? Yes

f) Was the airflow noticeable? Yes _____ No _____
Comfortable? Yes _____ No _____ Cold

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No _____ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes _____ No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes _____ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes _____ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt _____ hand _____

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

k)

My flow was strong enough to hit top of urinal and it went over the top - it was not carried downward. Second and third parabola I watched and controlled the pressure so it did not go too strong - feet were not in foot restraints. Because I did not want to wet my suit more I had to urinate slower. It seemed the urine was not drawn downward enough with the force I had. The last two parabolas were completed without full foot restraint but the visual control uncontrollable and unsuccessful - three parabolas and too empty bladder.

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 10

Date 28 Jan Data Sheet No. 1 Run No. 1

Subject Comments:

a) Was micturition accomplished? Yes ✓ No ____

b) Did the urinal collect the total micturition? Yes ✓ No ____

c) Was there any pooling of fluid in the pubic area during collection? Yes ____ No ✓ If yes, estimate quantity and describe location and pattern of contamination. ____

d) Was there any backsplash onto yourself or the seat area during collection? Yes ✓ No ____ If yes, estimate quantity and describe location and pattern of splash. I think I felt some

e) How many vaginal wipes were used? 2

f) Was the airflow noticeable? Yes ✓ No ____ Comfortable? Yes OK No ____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes ____ No ✓ If yes, explain ____

h) Was the seat comfortable and acceptable for use during collection? Yes OK No ____ Describe/explain ____

i) Was the positioning jet effective in locating you for use of the system? Yes ____ No ____ Describe/explain if any problems ____

j) Were the provided restraint devices effective during collection? Yes ✓ No ____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. a little back rest would help comfort

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 7

Date 29 Jan 74 Data Sheet No. 2 Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes ✓ No _____ If yes, estimate quantity and describe location and pattern of contamination. throughout voiding had urination that urine washed around before being sucked (see

d) Was there any backsplash onto yourself or the seat area during collection? Yes ✓ No _____ If yes, estimate quantity and describe location and pattern of splash. away so that there was a definite feeling of dampness in pubic area.

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes ✓ No _____
Comfortable? Yes _____ No ✓ Cool but not as bad as yesterday.

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain except for being cold.

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 3

Date 21 Jun 74 Data Sheet No. 2 Run No. 2

Subject Comments:

a) Was micturition accomplished? Yes X No ____

b) Did the urinal collect the total micturition? Yes ____ No ____ ?

c) Was there any pooling of fluid in the pubic area during collection? Yes ____ No X If yes, estimate quantity and describe location and pattern of contamination. ____

d) Was there any backsplash onto yourself or the seat area during collection? Yes ____ No X If yes, estimate quantity and describe location and pattern of splash. ____

e) How many vaginal wipes were used? 2

f) Was the airflow noticeable? Yes X No ____
Comfortable? Yes X-CAL No ____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes ____ No X If yes, explain ____

h) Was the seat comfortable and acceptable for use during collection? Yes X No ____ Describe/explain ____

i) Was the positioning jet effective in locating you for use of the system? Yes X No ____ Describe/explain if any problems ____

j) Were the provided restraint devices effective during collection? Yes X No ____ What restraint devices were used during zero-gravit collection? foot and lap belt X hand X

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. ____

I felt that the urine ran backward but since the air was cold this could have contributed to this sensation

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 6

Date 29 Jan 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of splash. _____

e) How many vaginal wipes were used? 2

f) Was the airflow noticeable? Yes ✓ No _____
Comfortable? Yes _____ No ✓

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 12

Date 1/29/74 Data Sheet No. 1 Run No. 2

Subject Comments:

a) Was micturition accomplished? Yes ✓ No ____

b) Did the urinal collect the total micturition? Yes ✓ No ____

c) Was there any pooling of fluid in the pubic area during collection? Yes ____ No ✓ If yes, estimate quantity and describe location and pattern of contamination. ____

d) Was there any backsplash onto yourself or the seat area during collection? Yes ____ No ✓ If yes, estimate quantity and describe location and pattern of splash. ____

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes ✓ No ____ Comfortable? Yes ✓ No ____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes ____ No ✓ If yes, explain ____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No ____ Describe/explain ____

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No ____ Describe/explain if any problems ____

j) Were the provided restraint devices effective during collection? Yes ✓ No ____ What restraint devices were used during zero-gravit collection? ~~[illegible]~~ and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. ____

Very little adjustment needed - worked fine first time

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 5

Date 29 June Data Sheet No. _____ Run No. 5

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of splash. _____

e) How many vaginal wipes were used? 2

f) Was the airflow noticeable? Yes ✓ No _____
Comfortable? Yes ✓ No _____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt _____ hand _____

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 11

Date 4/29/74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes X No _____

b) Did the urinal collect the total micturition? Yes X No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No X If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No X If yes, estimate quantity and describe location and pattern of splash. _____

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes X No _____
Comfortable? Yes _____ No X WAS LIKE AN ICE CUBE

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No X If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes X No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes X No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes X No _____ What restraint devices were used during zero-gravity collection? foot and lap belt X hand X

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 10

Date 29 Sept Data Sheet No. 2 Run No. 3

Subject Comments:

a) Was micturition accomplished? Yes ✓ No ____

b) Did the urinal collect the total micturition? Yes ✓ No ____

c) Was there any pooling of fluid in the pubic area during collection? Yes ____ No ✓ If yes, estimate quantity and describe location and pattern of contamination. ____

d) Was there any backsplash onto yourself or the seat area during collection? Yes ____ No ✓ If yes, estimate quantity and describe location and pattern of splash. ____

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes ✓ No ____ Comfortable? Yes ____ No cold particle (positioning jet)

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes ____ No ✓ If yes, explain ____

h) Was the seat comfortable and acceptable for use during collection? Yes ____ No ____ Describe/explain Fairly so — contour not quite comfortable

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No ____ Describe/explain if any problems ____

j) Were the provided restraint devices effective during collection? Yes ✓ No ____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. ____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 4
Date 29 Jan 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes Y No _____

b) Did the urinal collect the total micturition? Yes Y No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No Y If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No X If yes, estimate quantity and describe location and pattern of splash. _____

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes Y No _____
Comfortable? Yes _____ No X cold

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No Y If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes Y No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes Y No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes Y No _____ What restraint devices were used during zero-gravity collection? foot and lap belt Y hand Y

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 9

Date 27 Jan Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes ✓ No _____ If yes, estimate quantity and describe location and pattern of contamination. could feel it spreading over cheeks

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No X If yes, estimate quantity and describe location and pattern of splash.

e) How many vaginal wipes were used? ✓ one - very wet

f) Was the airflow noticeable? Yes ✓ No _____
Comfortable? Yes _____ No ✓ too cold but not as cold as yesterday - estimate windchill factor at 30° instead of -5°

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No X If yes, explain

h) Was the seat comfortable and acceptable for use during collection? Yes _____ No ✓ Describe/explain ischial tuberosities rest on a ridge (or on the inner ring)

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent.
tried rig without hand restraints & felt I was floating off the seat so did not urinate until I held on & drew myself down on the seat

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 1
Date 29 Jan 74 Data Sheet No. 1 Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes ✓ No _____ If yes, estimate quantity and describe location and pattern of contamination. Urine remained & pooled in area of pubic area before going down into tube

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of splash.

e) How many vaginal wipes were used? 2

f) Was the airflow noticeable? Yes _____ No ✓
Comfortable? Yes ✓ No _____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand during zero g

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. I found it very comfortable & easy to use. Even like pooling urine was not uncomfortable.

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 8

Date 1-29-74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes X No _____

b) Did the urinal collect the total micturition? Yes X No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No X If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes X No _____ If yes, estimate quantity and describe location and pattern of splash. Small amt splashed around front + sides of urinal also ran down on buttocks.

e) How many vaginal wipes were used? 3

f) Was the airflow noticeable? Yes X No _____
Comfortable? Yes X No _____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No X If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes X No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes X No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes X No _____ What restraint devices were used during zero-gravity collection? foot and lap belt X hand X

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____
Warm air much better. Foot stool seems a little high for tall people like me. Backs of my thighs still a bit up and not contacting urinal - even w boots off.

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 11

Date 2-[illegible]-[illegible] Data Sheet No. 2 Run No. 3

Subject Comments:

a) Was micturition accomplished? Yes X No ____

b) Did the urinal collect the total micturition? Yes X No ____

c) Was there any pooling of fluid in the pubic area during collection? Yes ____ No X If yes, estimate quantity and describe location and pattern of contamination. ____

d) Was there any backsplash onto yourself or the seat area during collection? Yes X No ____ If yes, estimate quantity and describe location and pattern of splash. ____

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes X No ____
Comfortable? Yes ____ No STILL COLD BUT MORE COMFORTABLE

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes ____ No X If yes, explain ____

h) Was the seat comfortable and acceptable for use during collection? Yes X No ____ Describe/explain ____

i) Was the positioning jet effective in locating you for use of the system? Yes X No ____ Describe/explain if any problems ____

j) Were the provided restraint devices effective during collection? Yes X No ____ What restraint devices were used during zero-gravity collection? foot and lap belt X hand X

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. ____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 12

Date 1/30/74 Data Sheet No. 1 Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of splash. _____

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes ✓ No _____ Comfortable? Yes ✓ No _____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

No problem - Worked fine.

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 2
Date 30 Jan 24 Data Sheet No. 3 Run No. 3

Subject Comments:

a) Was micturition accomplished? Yes X No____

b) Did the urinal collect the total micturition? Yes X No____

c) Was there any pooling of fluid in the pubic area during collection? Yes____ No X If yes, estimate quantity and describe location and pattern of contamination. ____

d) Was there any backsplash onto yourself or the seat area during collection? Yes____ No X If yes, estimate quantity and describe location and pattern of splash. ____

e) How many vaginal wipes were used? 2

f) Was the airflow noticeable? Yes X No____
Comfortable? Yes X No____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes____ No X If yes, explain ____

h) Was the seat comfortable and acceptable for use during collection? Yes X No____ Describe/explain ____

i) Was the positioning jet effective in locating you for use of the system? Yes X No____ Describe/explain if any problems ____

j) Were the provided restraint devices effective during collection? Yes X No____ What restraint devices were used during zero-gravity collection? foot and lap belt X hand X

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. ____

During O2 I was unable to keep my thighs touching the device unless I pulled on the hand restraints

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 7
Date 30 Jan 74 Data Sheet No. 3 Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____ except backwash into larger angle

c) Was there any pooling of fluid in the pubic area during collection? Yes ✓ No _____ If yes, estimate quantity and describe location and pattern of contamination. Continue to have backflow.

d) Was there any backsplash onto yourself or the seat area during collection? Yes ✓ No _____ If yes, estimate quantity and describe location and pattern of splash. Rim of urinal which fits over fecal collector was definitely wet. I was also damp.

e) How many vaginal wipes were used? 2

f) Was the airflow noticeable? Yes ✓ No _____
Comfortable? Yes ✓ No _____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 7

Date _____ Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes ✓ No _____ If yes, estimate quantity and describe location and pattern of contamination. felt some urine flowing over skin toward rear

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of splash.

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes ✓ No _____
Comfortable? Yes ✓ No _____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain

i) Was the positioning jet effective in locating you for use of the system? Yes _____ No _____ Describe/explain if any problems

I was apparently in the right position today, (as yesterday) initially

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand _____

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent.

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 6

Date 28 Jun 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes ✓ No _____

b) Did the urinal collect the total micturition? Yes ✓ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No _____ If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No ✓ If yes, estimate quantity and describe location and pattern of splash. when using wipes was still wetted from yesterday

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes ✓ No _____
Comfortable? Yes _____ No ✓

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No ✓ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes ✓ No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes ✓ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes ✓ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt ✓ hand ✓

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 5

Date 4-30-74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes X No _____

b) Did the urinal collect the total micturition? Yes X No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No X If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No X If yes, estimate quantity and describe location and pattern of splash. _____

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes X No _____
Comfortable? Yes X No _____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No X If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes X No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system? Yes X No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes X No _____ What restraint devices were used during zero-gravity collection? foot and lap belt X hand X

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

Seemed to do better today - maybe just getting accustomed to it.

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 1

Date _____ Data Sheet No. _____ Run No. 3

Subject Comments:

a) Was micturition accomplished? Yes _____ No _____

b) Did the urinal collect the total micturition? Yes _____ No _____

c) Was there any pooling of fluid in the pubic area during collection? Yes _____ No _____ If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection? Yes _____ No _____ If yes, estimate quantity and describe location and pattern of splash. _____

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes _____ No _____
Comfortable? Yes _____ No _____

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No _____ If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection? Yes _____ No _____ Describe/explain better than yesterday

i) Was the positioning jet effective in locating you for use of the system? Yes _____ No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection? Yes _____ No _____ What restraint devices were used during zero-gravity collection? foot and lap belt _____ hand _____

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

URINE COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject No. 4

Date 30 Jan 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was micturition accomplished? Yes X No _____

b) Did the urinal collect the total micturition? Yes X No _____ ? some ran back.

c) Was there any pooling of fluid in the pubic area during collection?
Yes _____ No X If yes, estimate quantity and describe location and pattern of contamination. _____

d) Was there any backsplash onto yourself or the seat area during collection?
Yes _____ No _____ If yes, estimate quantity and describe location and pattern of splash. ? - Possibly some to back of system

e) How many vaginal wipes were used? 1

f) Was the airflow noticeable? Yes X No _____
Comfortable? Yes _____ No X very cold

g) Was there any problem presented by the movable urinal during zero-gravity operation? Yes _____ No X If yes, explain _____

h) Was the seat comfortable and acceptable for use during collection?
Yes X No _____ Describe/explain _____

i) Was the positioning jet effective in locating you for use of the system?
Yes X No _____ Describe/explain if any problems _____

j) Were the provided restraint devices effective during collection?
Yes X No _____ What restraint devices were used during zero-gravity collection? foot and lap belt X hand X

k) List any other general comments on the performance of the urinal or use of the system during zero-gravity that you consider pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 11

Date 1 Feb 24 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes X (2nd) No _____
Was micturition accomplished? Yes X No _____

b) Did the commode collect the bolus? Yes X No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes 1 No _____ If yes, how much? none

e) Could you feel the airflow? Yes X No _____
Was it acceptable? Yes _____ No _____ very cold

f) Was there adequate wipe access? Yes X No _____

g) How many wipes did you use? anal 1 vaginal 1

h) Was the positioning jet effective in locating you for use of the commode?
Yes X No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes X No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes X No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 10

Date 1 1 Feb Data Sheet No. _____ Run No. 4

Subject Comments:

a) Was defecation accomplished? Yes _____ No _____

Was micturition accomplished? Yes _____ No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?

Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes _____ No _____

Was it acceptable? Yes _____ No _____

f) Was there adequate wipe access? Yes _____ No _____

g) How many wipes did you use? anal _____ vaginal 1

h) Was the positioning jet effective in locating you for use of the commode?

Yes _____ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?

Yes _____ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes _____ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. A - OK

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: G

Date 1 Feb 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No ✓
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal _____ vaginal 2

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject:

Date 1/1 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No ✓

Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?

Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____

Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes _____ No _____

g) How many wipes did you use? anal _____ vaginal _____

h) Was the positioning jet effective in locating you for use of the commode?

Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?

Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. found the system comfortable but the airflow is too cold

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: /

Date / Data Sheet No. / Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No X
Was micturition accomplished? Yes _____ No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes X No _____
Was it acceptable? Yes X No _____

f) Was there adequate wipe access? Yes X No _____

g) How many wipes did you use? anal 3 vaginal /

h) Was the positioning jet effective in locating you for use of the commode?
Yes X No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes X No _____ Describe/explain sat through & PF seat was Comfortable

j) Were the restraint devices effective during collection? Yes X No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 1

Date 4 Feb 7- Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes ✓ No _____
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes ✓ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No ✓ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal _____ vaginal _____

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: /

Date 4 Feb Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No V

Was micturition accomplished? Yes / No _____

b) Did the commode collect the bolus? Yes N/A No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?

Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____

Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes _____ No _____

g) How many wipes did you use? anal _____ vaginal 2

h) Was the positioning jet effective in locating you for use of the commode?

Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?

Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: -

Date 4 Feb 73 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No ✓
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes ✓ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes ✓ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal _____ vaginal ✓

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: #3

Date 4 Feb 73 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes ✓ No _____
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes ✓ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes ~~✓~~ No ✓ If yes, how much? seemed very little

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal 1 vaginal 1

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. I crossed anual between thighs + held under the seat. Seemed to keep anal gap open + system did work better.

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 2
Date 4 Feb 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No X
Was micturition accomplished? Yes X No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes X No _____
Was it acceptable? Yes X No _____

f) Was there adequate wipe access? Yes _____ No _____

g) How many wipes did you use? anal _____ vaginal 1

h) Was the positioning jet effective in locating you for use of the commode?
Yes X No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes X No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes X No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent.
Urine came up over top at one point, but did go down the proper channel.

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 1

Date 4 Feb 24 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No X

Was micturition accomplished? Yes X No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?

Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes X No _____

Was it acceptable? Yes X No _____ cold

f) Was there adequate wipe access? Yes X No _____

g) How many wipes did you use? anal _____ vaginal 3

h) Was the positioning jet effective in locating you for use of the commode?

Yes X No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?

Yes X No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes X No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. Was trying to keep my thighs apart - there was much more leakage to the seam of the commode - Also much splashing & wetting of wipes (neg-G)

C3

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 3

Date 5 Feb 73 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No ✓

Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes ✓ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____ N/A

d) Could you determine if you were excessively soiled?

Yes _____ No _____ If yes, how much? N/A

e) Could you feel the airflow? Yes ✓ No _____

Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal _____ vaginal ✓

h) Was the positioning jet effective in locating you for use of the commode?

Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?

Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 9

Date 5 FEB Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No ✓
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes _____ No ✓ too cold today

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal _____ vaginal ✓

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 4

Date 5 Feb 71 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes X No _____
Was micturition accomplished? Yes X No _____

b) Did the commode collect the bolus? Yes X No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No X

d) Could you determine if you were excessively soiled?
Yes X No _____ If yes, how much? not soiled

e) Could you feel the airflow? Yes X No _____
Was it acceptable? Yes X No _____ cold

f) Was there adequate wipe access? Yes X No _____

g) How many wipes did you use? anal 1 vaginal 1

h) Was the positioning jet effective in locating you for use of the commode?
Yes X No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes X No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes X No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 10

Date 5 [illegible] Data Sheet No. _____ Run No. 4

Subject Comments:

a) Was defecation accomplished? Yes _____ No ✓
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal _____ vaginal ✓

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. A-OK

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 15

Date 5 Feb 91 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No ✓
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal _____ vaginal 2

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 7
Date 5 Feb 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No ✓
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes _____ No _____ N/A

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal _____ vaginal 2

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. Occasional splashing under right thigh as seat + leg was wet. Also felt that most of urine was going into fecal collector with urinal. Seemed unable to correct from parabola to parabola so continued during all 4 when voided.

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 3

Date 5 Feb 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No X
Was micturition accomplished? Yes X No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes X No _____
Was it acceptable? Yes X No _____

f) Was there adequate wipe access? Yes X No _____

g) How many wipes did you use? anal _____ vaginal 2

h) Was the positioning jet effective in locating you for use of the commode?
Yes X No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes X No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes X No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent.
The odor when the system is turned on is very unpleasant

NOTE: APPEARS TO BE COMING FROM POSITIONING JET LINE - NOT SURE WHAT IT IS

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: Gene Scott Mahr 2

Date 2-6-74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No ✓

Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?

Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____

Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes _____ No _____

g) How many wipes did you use? anal _____ vaginal _____

h) Was the positioning jet effective in locating you for use of the commode?

Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?

Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent.

NOTE: URINAL WAS PLACED 1/2 WAY TOWARD BACK, STAYED WITHOUT DIFFICULTY.

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 4

Date 6 Feb 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes X No _____
Was micturition accomplished? Yes X No _____

b) Did the commode collect the bolus? Yes X No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes X No _____ 1st o/k
1 SECOND BOLUS APPEARED TO AT PULLOUT

d) Could you determine if you were excessively soiled?
Yes X No _____ If yes, how much? minimal - I thought soiling was worse than it was

e) Could you feel the airflow? Yes X No _____
Was it acceptable? Yes X No _____ cold

f) Was there adequate wipe access? Yes X No _____

g) How many wipes did you use? anal 2 (one would have been enough) vaginal 1

h) Was the positioning jet effective in locating you for use of the commode?
Yes X No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes X No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes X No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 13
Date Feb 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes ✓ X 2 No _____
Was micturition accomplished? Yes ✓ X 2 No _____

b) Did the commode collect the bolus? Yes ✓ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No ✓ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal 1 vaginal 1

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: Mac #3

Date 6 [illegible] '84 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No ✓

Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes _____ No ✓

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?

Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____

Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes _____ No _____

g) How many wipes did you use? anal _____ vaginal _____

h) Was the positioning jet effective in locating you for use of the commode?

Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?

Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

Even with restrained flight boots feet were adequately

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent.

acceptable method for male urination and defecation.

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: Male #1 [redacted] Height 6'5" Weight 245

Date 6 FEB 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes ✓ No _____
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes ✓ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No X If yes, how much? _____

e) Could you feel the airflow? Yes X No _____
Was it acceptable? Yes X No _____

f) Was there adequate wipe access? Yes X No _____

g) How many wipes did you use? anal 3 vaginal _____

h) Was the positioning jet effective in locating you for use of the commode?
Yes X No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes X No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes X No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. Would prefer the urine collector a little higher - indigent position

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 7
Date 6 Feb 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes ✓ No _____
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes ✓ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes ✓ No _____ If yes, how much? Moderately, but had very loose stool which contributed

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal 5 vaginal 1

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain Except noticed some swirling on back of fecal collector tube.

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 7

Date 7 Feb 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes ✓ No _____
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes ✓ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes ✓ No _____ If yes, how much? Suitcamed and was not about same as at 1 D.

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal 4 vaginal _____

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain Didn't really feel necessary as always on target & adjustment of position not necessary.

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 4
Date 2 Feb 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes X No _____
Was micturition accomplished? Yes X No _____

b) Did the commode collect the bolus? Yes X No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No X

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? not soiled

e) Could you feel the airflow? Yes X No _____
Was it acceptable? Yes X No _____

f) Was there adequate wipe access? Yes X No _____

g) How many wipes did you use? anal 1 vaginal 1

h) Was the positioning jet effective in locating you for use of the commode?
Yes _____ No _____ Explain not needed

i) Was the seat comfortable and acceptable for use during collection?
Yes X No _____ Describe/explain: _____

j) Were the restraint devices effective during collection? Yes X No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject:

Date 2-7-74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes _____ No _____
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes _____ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No _____ If yes, how much? _____

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes _____ No _____

g) How many wipes did you use? anal _____ vaginal _____

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 1

Date 7 Feb 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes ✓ No _____
Was micturition accomplished? Yes _____ No ✓

b) Did the commode collect the bolus? Yes ✓ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes ✓ No _____ On the second parabola, the bolus did not completely separate

d) Could you determine if you were excessively soiled?
Yes _____ No ✓ If yes, how much? Somewhat soiled but nothing unusual

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____ but very cold

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal 5 vaginal _____

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain I prefer to have a positioning jet to assure that I am seated properly

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. I think the system performed very well and I feel that there won't be much trouble in soiling during defecation at a constant zero G. I think the fact that we were in 2 G also contributed to soiling.

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 3

Date 7 Jul 71 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes ✓ No _____
Was micturition accomplished? Yes ✓ No _____

b) Did the commode collect the bolus? Yes ✓ No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes _____ No _____

d) Could you determine if you were excessively soiled?
Yes _____ No ✓ If yes, how much? not soiled

e) Could you feel the airflow? Yes ✓ No _____
Was it acceptable? Yes ✓ No _____

f) Was there adequate wipe access? Yes ✓ No _____

g) How many wipes did you use? anal 1 vaginal 1

h) Was the positioning jet effective in locating you for use of the commode?
Yes ✓ No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes ✓ No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes ✓ No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. _____

FECES COLLECTION SUBJECTIVE ZERO-GRAVITY TEST DATA SHEET

Test Subject: 14

Date 7 FEB 74 Data Sheet No. _____ Run No. _____

Subject Comments:

a) Was defecation accomplished? Yes X No _____
Was micturition accomplished? Yes X No _____

b) Did the commode collect the bolus? Yes X No _____

c) If no, what happened? Did the bolus appear to stay at the anus with the pullout? Yes X No X

d) Could you determine if you were excessively soiled?
Yes _____ No X If yes, how much? _____

e) Could you feel the airflow? Yes X No _____
Was it acceptable? Yes X No _____

f) Was there adequate wipe access? Yes X No _____

g) How many wipes did you use? anal 6 vaginal _____

h) Was the positioning jet effective in locating you for use of the commode?
Yes X No _____ Explain _____

i) Was the seat comfortable and acceptable for use during collection?
Yes X No _____ Describe/explain _____

j) Were the restraint devices effective during collection? Yes X No _____

k) List any other general comments on the performance of the sytem during zero-gravity that you feel are pertinent. DURING DEFECATION AT ONE TIME FECES DID NOT SEPERATE till ONE MANEUVER LATER THE rest of the time SEPERATION WAS No Problem. Would like to see An Adjustable foot restraint. My foot would not fit IN restraint MAKE FWD + AFT remark on restraint

APPENDIX H

PRELIMINARY FLIGHT PROTOTYPE WASTE COLLECTION SUBSYSTEM TEST SUBJECT GENERAL COMMENTS

Mary Jane Koch

Hemi-m System -

- Very secure feeling when using the equipment.
- [illegible]
- Positive [illegible] -
- Easy to use
- No adjusting needed - Seems as natural as [illegible] and Comfortable
- Air jet doesn't seem necessary - positioning is easy without it
- Like the system - Very [illegible] feeling [illegible].

MJK

NOTE: TEST SUBJECT REPORTED UPON QUESTIONING THAT SHE DOES NOT USE FOOT RESTRAINT.

Hamilton Standard

The conventional type commode was convenient and comfortable, easily adjusted for use with minimum explanation. I was somewhat insecure initially because the law of air pressure might allow escape of urine but found that the system worked and consequently lost the feeling of insecurity. I believe the non-intimate contact would cause less cross contamination. I think the raptor seat would be more comfortable. The system seemed to function very efficiently.

Cady

Position Jet - Is it necessary? - (no).
Restraints - Do we need them all
which is best
belt - ?
foot - ✓
hand - ✓

NOTE: NOT REQUIRED FOR URINATION - DEFECATION MAY BE.

NOTE: REFERENCE TO SOFT SEAT IS MADE AS TEST SUBJECT HAD PREVIOUSLY TESTED SYSTEMS UTILIZING SOFT SEATS. SOFT SEAT WAS NOT MADE IN THE WCS II SYSTEM.

MALE

JOE HUNTER

OVERALL THE SYSTEM WORKED GOOD. THE CHANGES I WOULD RECOMMEND WOULD BE THE POSITION OF THE URINAL WOULD BE BETTER IF IT COULD BE RAISED ABOUT 1" HIGHER. ALSO THE FOOT RESTRAINT COULD BE MADE ADJUSTABLE AS I COULD NOT GET MY FOOT IN IT AND IT WAS TO CLOSE TO THE SYSTEM.

Gene Cooper -
MALE

Position jets were a great aid in getting into the proper position. The seat ~~was~~ was comfortable enough. I would like to see the urinal moved closer to the subject at a 45° angle or so. The foot restraints could be moved further away from the toilet

I think the HSD waste management system was a fairly comfortable one. The "non-intimate" contact is certainly more preferable than "intimate contact". I found the soft seat to be more comfortable than the hard seat. The foot restraints are easy to use and efficient. I also think all restraints (belt, foot, hand) are necessary in a 0-G situation.

I don't think the positioning jets were necessary. The contour of the seat precluded any real need for them.

Evelyn Dornbach

NOTE: SOFT SEAT AND INTIMATE CONTACT URINAL WERE NOT TESTED AS PART OF THIS PROGRAM. THE TEST SUBJECT HAD TESTED THEM IN A PREVIOUS TEST PROGRAM.

Maureen Jick

I like the basic configuration of the system. It was easy to use, simple to move around in space, open & close the back hole. I don't feel I have any problems with the system.

Position jet helpful for security + it was possible to defeate, but it should it would be required

Restraints were necessary -

I used all of it.

Seat was OK -

I liked your system very much. I do not think of any constructive [illegible]

I liked the naturalness of the sitting position. The seat was comfortable at all times. The restraints are all useful. I think the lap restraint might not be used for urination but would be used during the defecation since it takes a longer time. The positioning jets were useful the first several times I used the machine. After that I found that I would be in position and used the jets to feel secure that the position was correct. There may be a problem with the foot restraints and the people with the longer legs. I found it difficult to keep in contact with the seat even though I had the lap belt on tight. Being able to change the position of the feet might be a help.

I found it a comfortable method of waste management.

Carla B. Sekladan

I found the system, overall, to be easy to use and comfortable. I do think the positioning jet is necessary for me, even if it would just be an added security for some people. I also prefer all three types of restraints — foot belt + hand. I think if one were eliminated there would be too much flotation off the seat of the system. I did find the seat comfortable and I liked the fact that it was contoured which helped me position myself properly in addition to the positioning jet.

The only complaint I have about the system is the coldness of the airflow. I find I have the sensation of leakage but it is due to the airflow and not an actual leakage. Otherwise the system is comfortable, easy to use, and very effective for its intended purpose.

Karen L. O'Connor

~~end comfort~~
~~restraints~~ Bidder Wa.

Hamilton Standard

I found your system very satisfactory for both urine and fecal collection. The non-intimate urinal seemed very natural, however, there was more urine leakage to the rear of the commode when in the "comet" position with the legs more seperated.

The seat was comfortable in both 0-gravity & the pullout - the positioning jet was un-neccessary in my case as I never had to move after the jet was activated.

The foot restraints are very effective for positioning (mounting) & when combined with the lap belt provide adequate anchoring for use of the system.

Linda Howard

Like or Dislike - ease of use - Changes - positioning aid - Restraints

I liked the unit as far as comfort, seating and positioning. I prefer the ~~Lazy~~ contoured seat that is used because it was more like a conventional toilet. I was not uncomfortable at all in 2G or Zero G. The urinal was easy to move for wiping. I don't feel the positioning aid was necessary for me. I was positioned correctly before it was turned on but I suppose this was good to be really sure that I was in correct position. The restraints were adequate and I used all three. leg, foot and hand restraints. I was only able to void so I cannot evaluate the fecal collection but I can't imagine any problems as far as comfort.

Llewellyn Alspach

Having been raised as a child with all the comforts of an outdoor john in both winter + summer, I feel I was conditioned to withstand the frostbite Smile!

I felt the seat was a good design, comfortable enough, but I don't think I would choose to read a novel on it. As for having to spread the "cheeks" it would become a simple habit if used for extended periods. No sweat!

The positioning jet adds a bit of "spice" to life, but I never had to move when it was used just seemed to naturally be in the right place. Don't think it is really necessary.

The seat restraint fit beautifully, the foot holds were ok, especially needed for the "clean up" in Zero G. I'd buy the system —

Keep smiling

Patricia Haynes

It worked.

Positioning jets demonstrated that position was correct, but by positioning according to seat contours I found adjustment of position not necessary when checked by jets.

Seat was comfortable. Aware of bulge at back of seat when leaning back for increased thrust to accomplish defication, but "awareness" not uncomfortable. Seat positioning in restraints also comfortable. Mild anxiety caused by small diameter of fecal collection tubing, but demonstrated adequate.

All three restraints used and seemed necessary and adequate. Wore boots which were tight fit in restraints - no problems.

positioning jet - I don't have any objection to this. It seems to work & isn't uncomfortable. The only other way to center over the hole would be to make some indentations in the seat under the ischial tuberosities so the user could position him/her self - assuming, of course, that everyone's anus is the same distance from the ischial tuberosities. Just warm the air next time tho.

Seat comfort - No objections to the seat. My personal opinion is that it makes no difference whether or not the seat is hard or soft or contoured or not in ≥ zero G. Now 2 G is a different matter - - -.

restraints - need all 3. foot restraints are the most important because one can float in & hook the feet in & then undress easily. This is impossible using only a hand restraint. The foot restraints were a little too far back for me but I have long legs.

Had less trouble adjusting to this whole system than the others because it is most like a conventional 1 G john. The airflow in the back was too cold on several occasions altho the quantities were not objectional. Urine collection was acceptable altho I was not as dry as I one other rig but the difference was minimal & not objectional provided wipes are available.

GERRY 13

LIKE - DISLIKE — WHAT CHANGE

POSITIVE JET NEC? SEAT COMFORTABLE? RESTRAINTS?

System seemed to work well as a non-contact unit. I found the "non-contact" a factor that was very agreeable in using the unit. It's more natural. Don't know how I'd change foot restraint as to distance from unit. Still seems too high for "long-leggers".

Positioning jet was handy but seeing I didn't use it for fleas test - don't know how important it was. The seat was comfortable in Zero-G. I feel all 3 restraints are necessary. Hand holds are too high for long arms. I think they probably are only necessary for aiding defecation. Other restraints seem necessary all the time.

What are you planning for odor control in space? probably pretty necessary as positive jet causes bad odor.

All in all, system seems pretty good - sometimes urine flows back over buttocks because of position change - don't know how this would be in different environment, e.g. all Zero-G. No other problems.

NOTE: REFERRED TO DOCTOR, IT WAS FOUND ODOR WAS CAUSED BY DISINFECTANT BEING USED AND NOT BY SYSTEM; SEE DISCUSSION IN TEXT.

Shirley Fontes

2 uses - [Light for commode + ped + was not on before the first parabola

#1 - urine hit the front of urinal + over flowing - on the 1st parabola - 2nd + 3 parabola I had to lower the force to keep it from over flowing. It started to again [illegible] I did lower the force - I had to watch to see how it worked

2nd small volume no problem

Position [illegible] not uncomfortable but it hit the spot first time on both times. It is easy to to feel the position + see as you line up to the urinal over

foot, leg + hands restraints comfortable - seat comfortable

I did feel wet after both trips

That's all I can think of + this is all the paper I had.

It's been great - enjoyed it

Sorry I couldn't use the equipment more.

NOTE: BECAUSE OF ILLEGIBILITY THIS SHEET IS TYPED ON THE FOLLOWING PAGE.

REPRODUCIBILITY OF THE ORIGINAL PAGE IS POOR

2 Uses - (Light for camera tipped and was not on before the first parabola).

#1 - Urine hit the front of urinal and overflowed on the first parabola. 2nd and 3rd parabola I had to lower the force to keep it from overflowing. It started to again before I did lower the force - I had to watch to see how it worked.

#2 - Small volume no problem. Position jet not uncomfortable. It hit the spot first time on both times. It is easy to feel the position and see as you line up to the urinal. Foot, lap and hand restraints comfortable. I did feel wet after both trips. That's all I can think of and this is all the paper I had.

It's been great - enjoyed it - sorry I couldn't use the equipment more.