ASD TECHNICAL REPORT 61-524

INTEGRATION OF PERSONAL EQUIPMENT

DAVID CLARK COMPANY INCORPORATED

OCTOBER 1961

AERONAUTICAL SYSTEMS DIVISION

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DIRECTORATE OF OPERATIONAL SUPPORT ENGINEERING
CONTRACT No. AF 33(616)-6444
PROJECT No. 3325
TASK Nos. 63750, 63751, 63752, 63754

AERONAUTICAL SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
WRIGHT-PATTERSON AIR FORCE BASE, OHIO

300 - December 1961 - 15-619

FOREWORD

This report was prepared by the David Clark Company Incorporated, Worcester, Massachusetts, on Air Force Contract AF 33(616)-6444, under Task Numbers 63750, 63751, 63752, 63754 of project number 6325, which is "Integration of Personal Equipment". The work was administered under the direction of the Directorate of Operational Support Engineering, Aeronautical Systems Division, with Technical Monotoring being performed by Mr. Ronald S. Huey and Mr. William L. Benson of the Personal Equipment Branch. The studies presented began in March 1959 and were concluded in April 1961 and represent a joint effort of the analysis and evaluation group at the laboratory and the development group of the David Clark Company Incorporated.

The report was prepared under the direction of A. J. Kenneway, Project Director. The cooperation of the following development and administrative personnel made this report possible: Joseph A. Ruseckas - Research Director, Mr. Forrest Poole - Design Engineer, Mr. Richard Murdock - Photography, Mr. James Garrepy - Design Technician, Mrs. Margaret Plante - Editing and preparation of copy for reproduction.

This report concludes the work on Contract AF 33(616)-6444.

ABSTRACT

This report describes the various efforts, methods of approach and solutions to some of the problems of integrating items of air crew personal equipment. The major problems of integration is the combining of the various individual items, which have specific functions with each other, without complicating these combinations beyond their effectiveness limits. Practical solutions were achieved in some areas but additional work is required in others.

PUBLICATION REVIEW

This report has been received and is approved.

FOR THE COMMANDER:

W. P. Shepardson
Chief, Crew Equipment Division
Directorate of Operational Support Engineering

S U M M A R Y

The integration problem has not been resolved in all the areas undertaken due to the extensive and continually changing scope of the United States Air Force operations under extremely variable environments. Performance under this contract has resulted in a higher degree of utilization under more diversified conditions than before; however, the major problem of integrating the personal equipment required for cold weather, land and water survival and high altitude survival, without combining all the items into one unit, has not been satisfactorily resolved. A review of the attempts to integrate the anti-exposure coverall and the altitude coverall and helmet has indicated definite progress, but requires that modifications be made in the standard components of the anti-exposure coverall and the pressure helmet. These modifications would not nullify the primary purpose of the items to be used separately as originally designed; however, some interchangeable sections would be required. A further review of attempts to integrate the life raft and the sleeping bag indicates progress in the direction of consolidation and reduction of weight, in an effort for continued miniaturization. With the introduction of the wet principle it would now be possible for a pilot to fly in a more comfortable immersion type suit, permitting greater endurance and ultimately more mobility in a survival situation.

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I. INTRODUCTION

As a result of the increased aircraft capabilities, any particular mission dictates the personal equipment protection configuration required essential to integrate the components of the various assemblies in order that maximum life saving protection, comfort and mobility may be afforded. Only through the best possible integration of individually required items is the aircrew member given optimum survival capability. Present and future mission requirements dictate the need for continued miniaturization, consolidation and reduction of weight and bulk in integrated personal equipment assemblies. Some results of the overall integration problems are presented in this report.

II. INTEGRATION OF SURVIVAL KITS (TASK 63750)

Heretofore aircrew members have been provided with either a one-man life raft for emergency use on over water flights, or a vacuum packed down filled sleeping bag for emergency use on over-land flights. These items are considered as most essential items of survival equipment for their respective areas. In addition to these items of equipment, it is mandatory that an anti-exposure suit be worn by crew members when flying over cold waters. Considering the fact that the increase in flight range of present day aircraft permits flights over a wide range of geographical areas in a single sustained flight, it becomes obvious that it is necessary to furnish air crewmen with all these essentials of emergency equipment. However, as aircraft range has increased, weight and space for such equipment has become more critical, thus, it is required to integrate these items into a single compact unit. Increase in air speeds has further complicated this problem requiring an air crewman to be ejected from aircraft fully equipped with all his survival equipment secured to his body.

Fabrication was pursuant to the development of an item capable of protecting a survivor under all conceivable emergency situations within the weight and space limitations and other performance requirements.

A. Integrated One-Man Life Raft/Sleeping Bag, Model #1.

1. Main cell of MB-4 configuration.
2. Inflatable floor.
3. Inflatable canopy.
4. Down filled sleeping bag.
5. Inflatable stabilizers.

   a. The main cell configuration followed that of the MB-4 as did the inflation assembly, in order to integrate with current rigid seat-style survival kits. (Figure 1).

   b. The use of an inflatable floor was determined to be advantageous in creating a dead space, thus providing insulating capabilities. (Figure 2).

   c. The inflatable canopy was fabricated of "Rigid-Aire", which, when inflated produced some rigidity as well as dead air space through the one inch square, interdependent pillow cells. (Figures 3 and 4).

Manuscript released by authors May 1961 for publication as an ASD Technical Report.

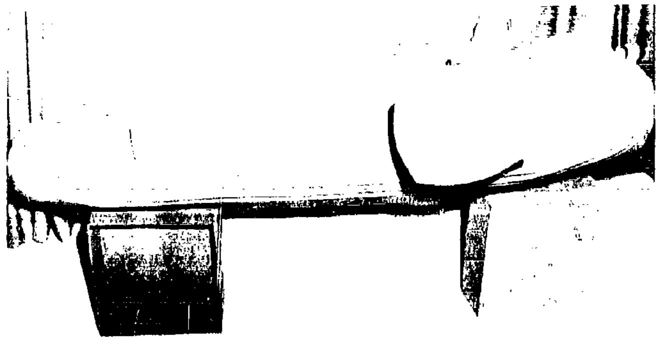

Figure 1

Main Cell Configuration, Model #1

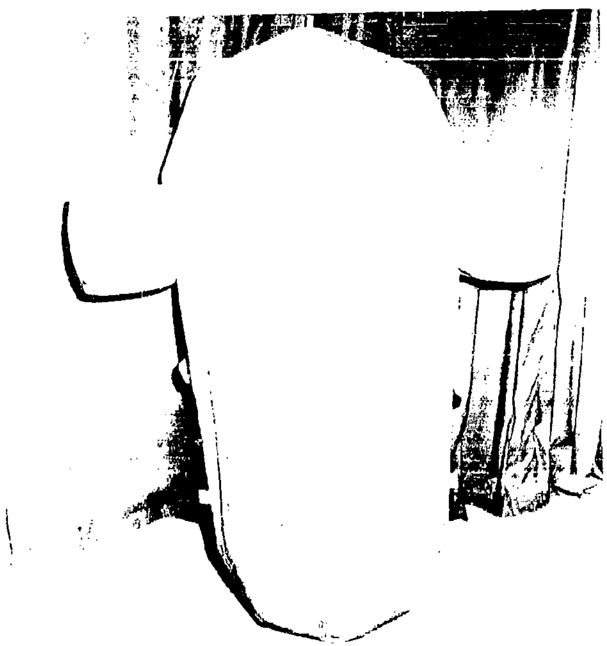

Figure 2

Inflatable Floor

Figure 3

Inflatable Canopy and Hood

Figure 4

Inflatable Canopy

d. The down filled sleeping bag is designed to accomodate the 99th percentile and is a separate part of the raft unit. It is stowed in a waterproof pocket attached to the main cell, around the inboard side of the canopy. (Figure 5).

Figure 5

Down Filled Sleeping Bag

e. The inflatable stabilizers are attached to the outboard sides of the main cell, at the center of gravity and are orally inflated. (Figure 6).

Through consultation with the Gerry Mountaineering Company, it was determined that to obtain adequate protection at -60° F., the insulation should be 3-1/2 to 4 inches thick. This insulation, in the form of goose down, was fabricated 3-1/2 to 4 inches thick and employed in model #1. Any additional thickness would not be additive to the clo unit value. Ultimately a sacrifice of compactness exists through excess weight and bulk.

B. Integrated Life Raft/Sleeping Bag, Model #2

1. Main cell - The use of a larger bottle was not necessary. The design concept of this raft/sleeping bag is entirely new. It consists of only four piece construction (Figure 7) and is of a single ply fabric, coated on one side only, basically a life preserver fabric. The insulation is contained on the inboard side, inside of the cell, completely around the circumference of the cell. The insulation

Figure 6

Inflatable Stabilizers

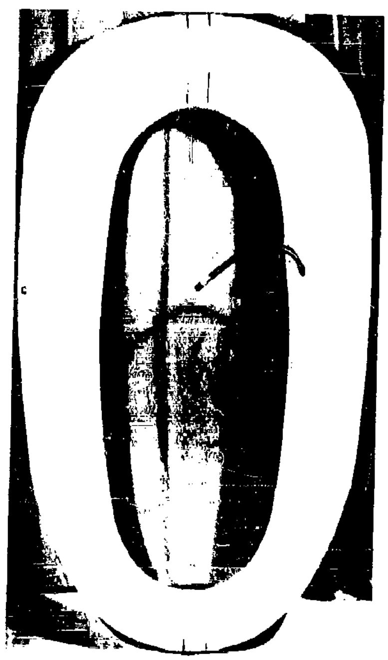

Figure 7

Redesigned Main Cell, Model #2

extends from the top center down to the bottom center. This insulation is tube type linear quilting, consisting of goose down.

2. Inflatable Floor - This consists of the basic cell fabric which is again the life preserver fabric. Construction is such that it is baffled (Figures 8 and 9). The top and bottom layers are joined together by means of porous baffles. The insulation is contained in porous tubes and then inserted between these baffles.

3. The Canopy - This canopy consists of a super structure of tubes or struts (Figure 10), to which a layer of coated flare cloth is cemented (Figures 11 and 12), both inside and out, creating a dead air space of approximately two inches (Figure 13). The method of closure was two slide fasteners, converging towards the center of gravity on closure (Figure 14). The struts are automatically inflated by means of the life preserver inflator with a twenty-eight gram cylinder (Figure 15).

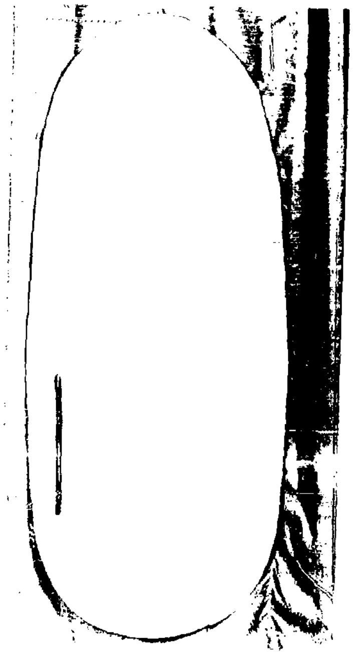

Figure 8

Inflatable Floor, Model #2

4. The Stabilizers - The stabilizers on this model are similar to model #1, but are detachable so that it would be at the discretion of the user if he chose to employ them under various survival conditions.

5. The flared tube bailer is employed in this model (Figures 16 and 17). The basic principle of this model is that all the insulation is located within the inflatable cells. There is no sub-unit or additional components to make up other survival equipment. The use of a larger bottle to offset the increased size of the main cell was determined unnecessary, primarily because adequate inflation is obtained with the standard cylinder (Figures 18 and 19).

The oral inflation tubes are 1/8 inch ID on the struts; throughout the rest of the raft all of the inflation tubes are 3/8 inch ID (Figure 20).

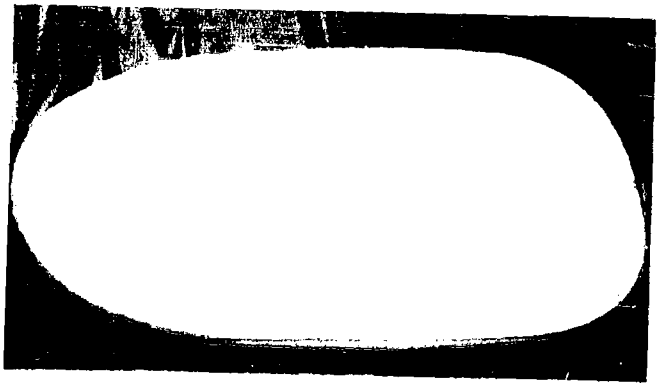

Figure 9

Inflatable Floor Installed, Model #2

Model #2 finally weighed, complete with cylinder and all attachments, 14 pounds, as compared to the standard raft which weighs approximately 11 pounds complete. The model #1 raft weighed approximately 22 pounds. This weight reduction is mainly due to the type of fabric and construction redesign used, as well as integrating the insulation within the various chambers in the life raft. Structurally this lighter weight fabric is capable of withstanding the required pressures and the normal treatment that it would get during survival use. Model #2 is now under evaluation at Aeronautical Systems Division for final determination of insulative characteristics, buoyancy and stability.

Figure 10

Canopy Superstructure

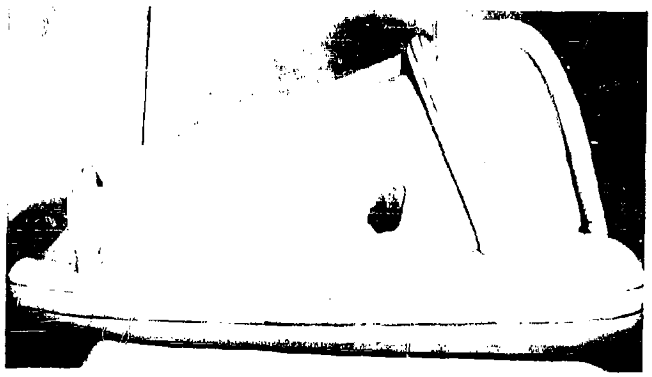

Figure 11

Canopy Inner Layer

Figure 12

Canopy Inner Layer, Partial Assembly

Figure 13

Canopy Inner and Outer Layer

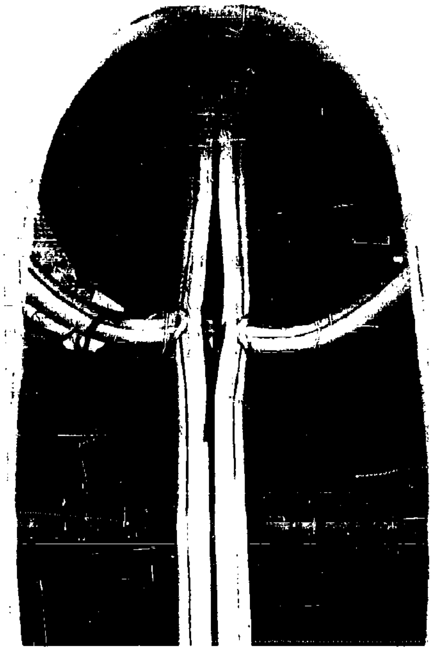

Figure 14

Canopy Closure Method

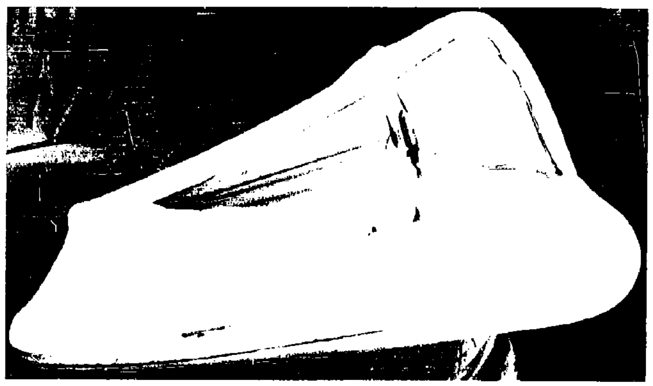

Figure 15

Automatic Strut Inflation

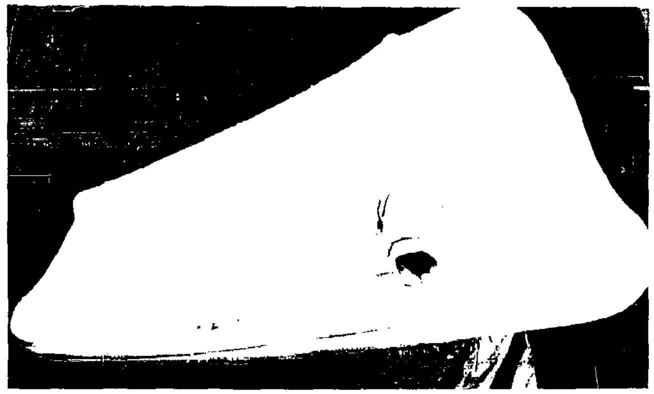

Figure 16

Flared Tube Bailer, Outboard

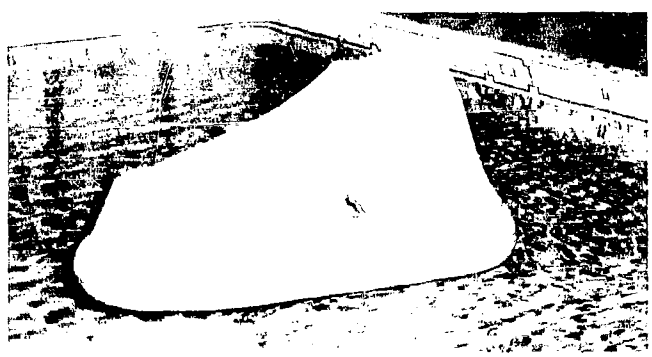

Figure 17

Flared Tube Bailer, Inboard

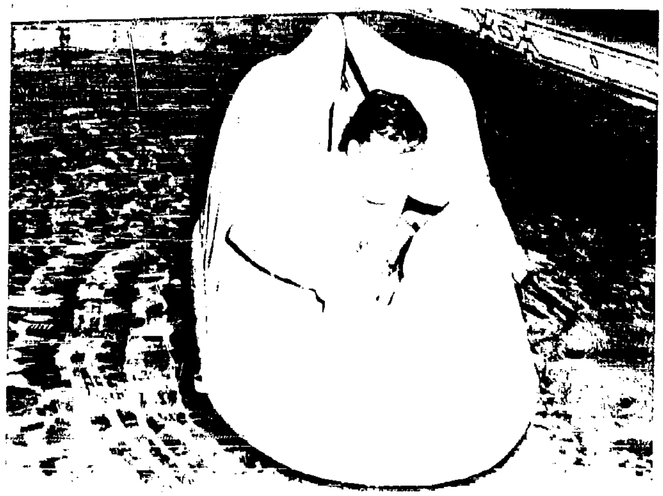

Figure 18

Flotation Characteristics

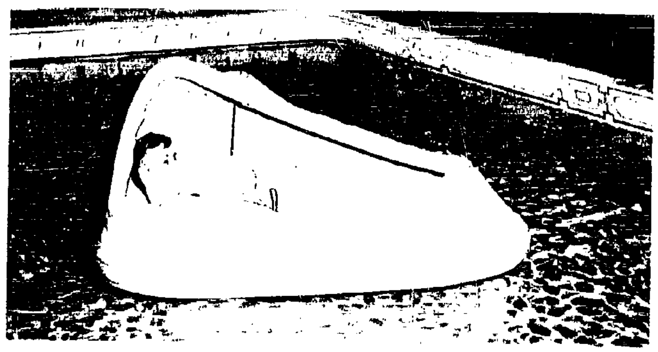

Figure 19

Freeboard Characteristics

Figure 20

Oral Inflation Tubes

C. Cold Water Survival Raft

1. A model is currently under development which has the same overall length as the model #2, but it does have reduced circumference in the main cell. There is no insulation throughout the entire raft. The floor in this raft is inflatable in the buttocks area only and is not permanently attached, thereby being removable. The canopy is basically of the same construction as model #2, except that the struts are reduced in diameter, thus reducing weight and volume. The closure on this model is of hook and pile nylon tape (Velcro). The flotation cells are the same as model #2 which are removable. The standard size cylinder is used in this model. With this cylinder, the main cell is inflated to approximately 5 PSI. It is conceivable that a reduced size cylinder can be used in the future. This model #3 will undergo evaluation at Aeronautical Systems Division.

D. Riser Cutter

1. The design of the cutter was intended to preclude the necessity of using two hands to open the standard hook blade knife. This cutter consisted of a straight shank six inches long, with two inches of blade area and four inches of handle area. A molded handle was used. Four types of compounds were evaluated. Basic part number was ACS-227, which consisted of a neoprene handle. ACS-227A consisted of a polyurethane handle, ACS-227B consisted of a nylon handle and ACS-227C was a polypropylene handle.

2. Various compounds were considered in order to determine which would have the least amount of slippage during actual use.

E. Flat Hook Blade Cutter

1. This model cutter was a redesign in which the blade had a configuration of a "French Curve". The reason for this approach was that the standard "U" type blade seemed to bind up when used to cut chute harness webbing. Consequently, with this crescent shape it was thought that ease in cutting would prevail. The handle on this knife was made of neoprene.

F. Support - In direct support of evaluating equipment in this category, the following items were delivered:

8	each	Parachutist's Equipment Stowage Bags, part number S-896.
100	each	Adjustment Strap Assemblies, part number AL-450.

III. INTEGRATION OF CLOTHING (TASK 63751)

A. Anti-Exposure Coverall - Integration Model

Previous attempts to integrate the standard MD-1 anti-exposure coverall with the following items resulted in difficult donning procedures, which nullified much of the value for alert conditions:

1. MA-3 High Altitude Helmet
2. MG-1 High Altitude Gloves
3. MC-3A High Altitude Coverall
4. CSU-3/P Anti-"G" Cut-a-way Garment
5. MB-2 Anti-"G" Coverall
6. MA-2 and MA-3 Ventilation Garment

A standard MD-1 anti-exposure coverall was redesigned at the neck section and attached to an outer ring (Figure 21). This outer ring was compatible with a new helmet bib which had the mating intermediate ring, (Figure 22) and was further compatible with the MA-3 helmet ring modified. Standard procedures for donning all of the above items were followed and the helmet portion was the last item to be donned (Figures 23 and 24), which was considered a definite advantage for alert conditions. The design of the two rings is such that water entry around the neck section is precluded. The ring on the exposure suit is snapped to the ring on the neck bib and held in place by means of a latching pin and sealed with an "O" ring. This anti-exposure suit was delivered as part number S-887.

B. MD-1 Anti-Exposure Coverall (Special).

This coverall was fabricated with measurements furnished by the laboratory and utilizing wrist and neck seals of a special fabric, also furnished by the laboratory. An eleven inch pressure sealing relief slide fastener was used. No boots were attached. In an effort to facilitate delivery, standard anti-exposure coverall patterns were employed where ever applicable. This item was delivered as part number S-574 (modified).

Figure 21
Integrated Anti-Exposure Coverall,
P/N S-877

Figure 22
Intermediate Bearing

Figure 23
Partially Donned Coverall

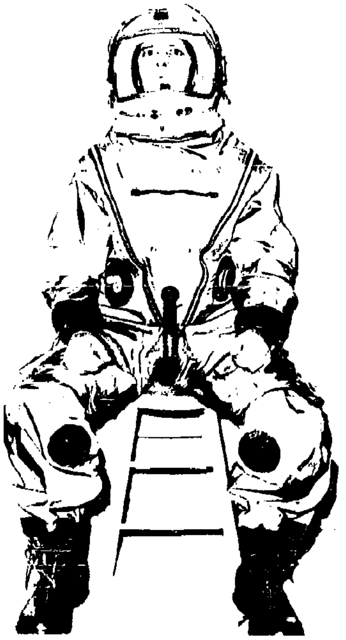

Figure 24
Fully Donned Coverall

C. Water Barrier Coverall

1. Employing the wet principle, this garment was fabricated using an air permeable, but water repellent fabric, with great abrasion resistance, designed and fabricated in a universal size. It was believed that upon entry into a life raft, the subject could quickly don this coverall and immediately be protected from the cold. Complete coverage of the body, with the exception of hands and face is accomplished by the addition of bootees. Water that has entered the suit during donning is released through small drain plugs located at the ankle area on both legs. For head protection a hood was provided which is similar to the one used with standard coveralls (Figure 25). This garment had a pressure sealing slide fastener, neck seal and wrist seals and was fabricated of Duplan "Weatherbar".

   These items were delivered as Water Barrier Coverall, part number S-883 and Water Barrier Hood, part number S-884.

Figure 25
Water Barrier Coverall, P/N S-883 and Hood S-884

2. Insulation Coverall

   Design of this coverall was in accordance with the eight size height-weight sizing program, size medium regular. The concept of this coverall was that of having an inner and outer shell of oxford weave nylon, with a spacer layer of trilock in between. This coverall would be worn during flight, while the outer water repellent coverall and hood would be packaged in the survival kit. The item that was submitted did not have pockets on it primarily for evaluating purposes (Figures 26 and 27). This coverall was delivered as part number S-885.

Figure 26
Insulation Coverall, Entry Openings

Figure 27
Insulation Coverall, P/N S-885

D. Water Barrier Coverall - Modified

1. Modifications included eliminating the water tight slide fastener and providing a tunnel entry (Figure 28) that was similar to the R-1 coverall, with a conforming neck closure, except that effort was made to improve the distribution of material when the tunnel is drawn closed about the neck (Figure 29). The coverall was designed to be packaged in the hood. The hood was redesigned (Figure 30) so as to change the insulation from that of Sunback to Thermesh and the use of "Weatherbar" was continued. These items were delivered as Water Barrier Coverall, part number S-883A and Water Barrier Hood, part number S-884A.

2. Insulation Coverall

The modified version of this liner was patterned after the MB-3A coverall, utilizing front opening slide fastener (Figure 31). The two shells of the liner were fabricated of "Weatherbar". The insulation was maintained as Trilock and was sealed. Due to this sealed insulation principle, it was necessary to install a bleed and check valve. These were located on the sleeve, at the top of the arm, midway between the wrist and elbow (Figure 32). The only pockets included on this prototype model were the ones for storing the gloves (Figure 32), this principle being that the gloves would upon bail-out, go with the man, so that upon water entry the gloves would already be on the man. They could be donned during parachute

Figure 28
Modified Water Barrier Coverall,
Tunnel Entry, P/N S-883A

Figure 29
Modified Water Barrier Coverall,
Tunnel Drawn Closed

Figure 30
Modified Hood, P/N S-884A

Figure 31
Modified Insulation Coverall,
Sealed, P/N S-885A

Figure 32
Glove Pockets and Bleed/Check Valves

Figure 33
Insulated Gloves, P/N ACS-234

descent to the water. A side pass-through opening was furnished, fabricated in a manner to minimize water transfer and yet designed so that a man could get to his inner garment. This insulation liner was delivered as part number S-885A.

3. Insulated Gloves

These gloves are designed in size large, are fabricated of "Weatherbar" fabric and have the Thermesh fabric as the insulation layer. The prime construction is that of stitching, with a coating of nylon primer over the stitching to seal off any perforations made during fabrication. The insulation provides protection while the hands are immersed in water. The wet principle is considered acceptable. These gloves are designed for quick donning and are compatible with the insulation liner wrist cuff (Figure 33). They further have a wrist adjustment strap. The gloves were delivered as Insulated Gloves, part number ACS-234.

E. Water Barrier Coverall - Altitude

This coverall is of one piece design, incorporating anti-exposure features that will integrate with the standard MC-3A, MC-4A High Altitude Coveralls, (Figure 34). The size of the garment is medium regular, in accordance with the eight height-weight sizing program. It further integrates with the MG-1 High Altitude Gloves, CSU-3/P Anti-G Suit and the MB-2 Anti-G Coverall, as well as the MA-2 and MA-3 Ventilation Garments (Figure 35). The entry is

Figure 34
Water Barrier Coverall, Altitude
P/N S-886

Figure 35
Water Barrier Coverall, Altitude
Partially Donned

located at the center back and is closed by means of a pressure sealing slide fastener (Figure 36). There are wrist seals, ankle seals and a neck seal on this version. These seals are of the coated Helanca variety. The basic fabric is Duplan "Weatherbar". There are four bleed and check valves, two on the forearm and two on the calf. Design concept of this suit is that of pre-flight donning, therefore, the outlets included in the integration of this suit (Figure 37) are:

ACS-109B	Breathing and Capstan Outlet Port
ACS-5	Ventilation Hose Outlet
ACS-87	Mark V Aperture for the G-Hose
P-1638	Glove Hose Pass Through

F. Insulation Coverall

1. Design criteria for this coverall is sealed insulation, continuous wear, anti-exposure coverall. There were two items fabricated - one size medium regular, one size large regular. The configuration was similar to that of the K2-B flight coverall, with modifications to integrate the CSU-4/P High Altitude Coverall (Figures 38 and 39). In order to obtain a clo value of approximately 1.5 units, a polyvinyl butyral coated nylon twill 3.03 ounces was used for the impermeable inner and outer shell of the coverall and a one-quarter inch thick quilted polypropylene batting sandwiched between cheesecloth was the medium for thermal insulation. The coveralls are designed in such a manner that no water can penetrate

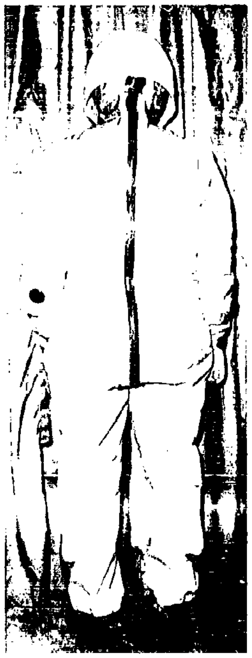

Figure 36
Pressure Sealing Entry

Figure 37
Integration Outlets

Figure 38
Sealed Insulation Coverall
P/N S-912

Figure 39
Sealed Insulation Coverall,
Integrated with CSU-4/P

the inner or outer shell and wet the insulation. The front closure is designed for ease of entry and provides the sealing action for a water permeable stretch type standup collar (Figure 40). Outlets were provided for the breathing bladder and the vent system of the CSU-4/P and an additional outlet for the CSU-3/P Anti-G suit is provided.

These outlets had rubber plugs (Figure 41) attached to the garment so that in the event the outlets were not used they could be plugged off, thereby precluding some water entry or transfer on water immersion. There is a bleed and check valve located on the lower left front leg. In addition there is the pencil pocket relocated on the forearm area, as on the CSU-4/P.

Figure 40
Front Closure and Stretch Neck

Figure 41
Outlet Plugs

2. The insulated gloves are of the same material characteristics as the basic suit with stitched assembly. The stitching is coated with Polyvinyl Butyral compound in order to seal off the insulation (Figure 42).

3. The insulated hood is designed so as to become a more form fitting garment over the head, neck and upper shoulder area. In order that this be compatible to any head size, a neoprene coated helanca insert was placed under the chin area (Figures 43, 44 and 45).

4. Attempts to secure an adequate seal for the basic fabric, polyvinyl butyral compound coated nylon, from which the coverall is fabricated, has resulted in a useable adhesive for these coveralls, but does lack

Figure 42
Insulated Gloves, P/N ACS-298

Figure 43
Insulated Hood, P/N ACS-299

Figure 44
Hood, Form Fitting About Head

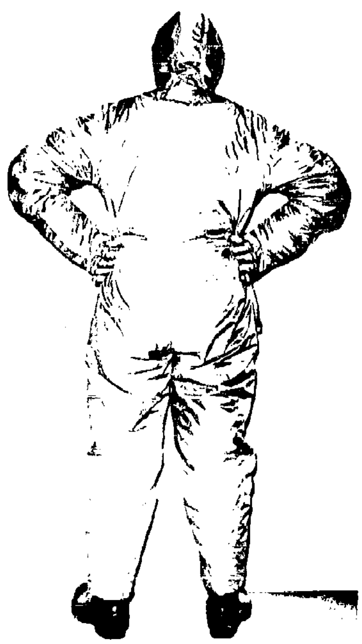

Figure 45
Hood, Form Fitting About Shoulders

some of the desirable characteristics. Several adhesive supply sources were approached, without success in finding a suitable adhesive. Ultimately, efforts should be made to develop an adhesive for use with PVB nylon fabric, which will have comparable bonding capability as does neoprene cement with neoprene coated fabric. The items delivered are Insulated Coverall, size medium regular, size large regular, part number S-912, Insulated Hood, universal size, part number ACS-299, Insulated Gloves, size universal, part number ACS-298.

G. Oxygen Hose Retention Fitting

1. A fitting which will prevent separation of MS-22001 oxygen mask hose from the mask during high "Q" forces due to wind blast, has been fabricated. This fitting does integrate without changes to the mask or hose. The design principle of this fitting provides a shoulder at the top portion of it which mates with the contour of the aperture on the base of the mask. This provides additional tangential support when there is a high degree of pull on it. The shoulder design feature should preclude any parting during high "Q" forces as opposed to the standard mask which simply has a short 3/4 to 7/8 inch sleeve inside the aperture.

H. In direct support of evaluating equipment in this category, the following items were delivered:

Drawings - Supply line adaptor, part number ACS-186
Drawings - For the supply line adaptor, part number AL-1304
Drawing - Sealing Disc, part number P-1603
Drawing - Oxygen hose retention fitting, part number P-1586
Instructions for donning neck seal assembly, part number S-889
7 yards - "Weatherbar", Duplan #2098, part number P-1621
8 yards - Velcro, female, part number P-1543
8 yards - Velcro, male, part number P-1542
Instructions for stowing coveralls S-883A, in hood S-884A
2 yards - Insulation material, Thermesh, cotton, Gehring No. 3055
4 each - Drain plug assemblies, part number ACS-202
1 set - Patterns for S-883, S-883A, S-886
8 each - Hose entrance pads, part number ACS-113B
1 each - Pneumatic back cushion, part number S-426-1A
6 each - Bulb assemblies for use on Lumbar support pad, bulb assembly, part number ACS-177
1 each - Valve, bleed check, part number ACS-229
1 each - Hand bulb, part number P-1747
12 each - Circle clamps, part number P-1576
12 each - Sockets, #4 flare, No. 1A1063-C
12 each - Plugs, aluminum, No. 1A1050-C
1 each - Mockup of proposed infield harness modification
1 each - Harness modification
1 each - Set of life preservers, design concept for evaluation of design only
1 pair - Exposure mittens, part number S-910A, for cold water evaluation at Truax Air Force Base

IV. CAPSULAR RESTRAINT AND ESCAPE SYSTEMS (TASK NO. 63752).

The criteria for maximum load is estimated for a 200 pound body at 33 "G". A preliminary study was made and detailed requirements were based primarily on projected capsule escape envelopes.

A. The initial approach to solving this problem was in the area of utilizing a harness restraint system. This system consisted basically of allowing the pilot to be relatively unrestricted in torso movement from the waist up. The preferred areas of restraint being the shoulders, chest and hips. This concept was utilized in the "Goodyear Capsule" in which the program was primarily for test and evaluation. This harness was delivered as part number S-887, Capsule Restraint Harness System.

B. The methods of providing restraint which integrates vacuum evacuated bladders were investigated. A test configuration was fabricated and consisted of the frontal area coverage vacuum bag (Figure 46), containing particles of solid materials which provided rigidity when the bladder was rapidly evacuated. This unit tentatively would remain in the aircraft and simply be hooked up after the crew member was in the operating position.

Figure 46

Frontal Coverage Vacuum Bag

C. Another approach was taken in which a vest and a cut-a-way shorts was utilized. This was a two fold effort that afforded adjustment for sizing and a pre-flight donned piece of equipment (Figures 47 and 48). There were two vacuum lines on the vest which provided more rapid evacuation in the upper torso area. The vacuum chambers on the shorts were in the general area of the Anti-G bladders, abdomen and upper thigh.

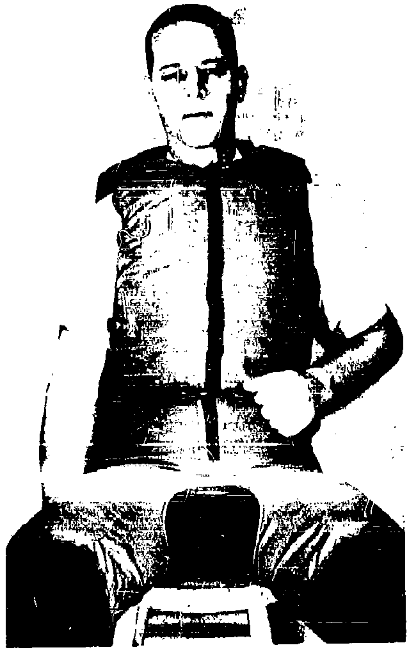

Figure 47
Vest and Cutaway Shorts

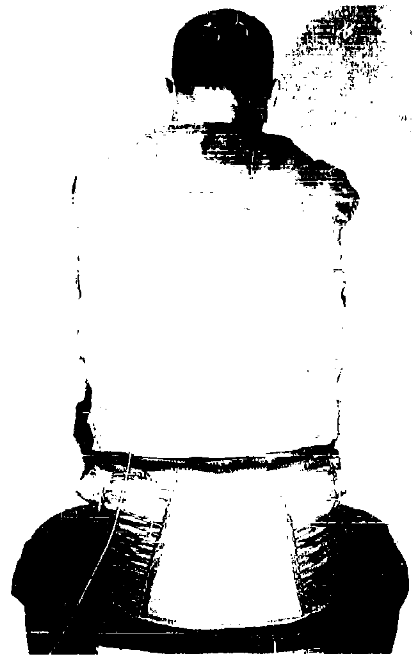

Figure 48
Adjustable Cutaway Shorts

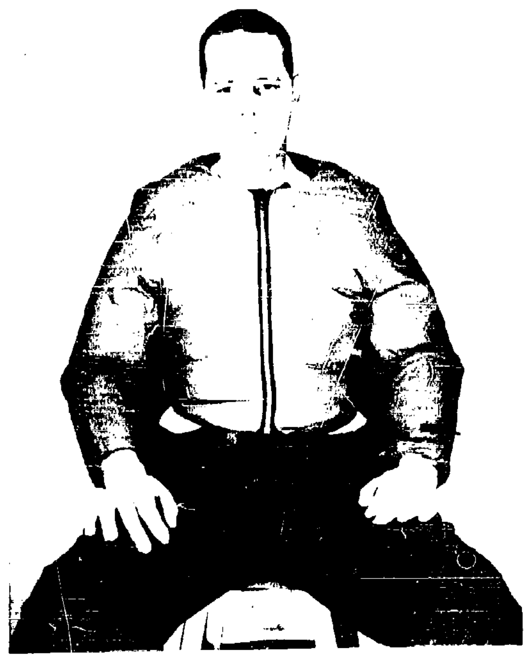

Figure 49
Integrated Jacket with Sleeves

An additional upper garment which included full length sleeves was provided (Figure 49). This item was interchangeable with the shorts and was an effort to provide additional coverage under a different mission profile.

D. Investigation of various solid material such as ground cork, potash, beans, lycopodium, magnesium oxide, actuated carbon pellets, aluminum pellets, proved to be a dual compromise. In the case where more rigid solid materials were evacuated in the bag, the weight of the unit was excessive, although the rigidity was satisfactory. In the case of the lighter weight materials, these proved to be unsatisfactory as far as rigidity was concerned.

V. INTEGRATION OF HELMETS (TASK NO. 63754)

Primary efforts in this area have been in the direction of integration of communication components, restraint devices and mask attachments, in future type helmets for utilization in capsular type escape systems or test and operational type vehicles.

A. Partial Pressure Suit Helmet

1. Sierra Engineering Company valve, part number 196 modified, is mounted on the left side of the helmet (Figure 50). A PSI line for the pneumatic seal was provided with the hose carried adjacent to the breathing hose and communications and mounted on the right side of the helmet (Figure 51). A Protection bearing is used for maximum mobility. A face barrier is used on this version (Figure 52). The Roanwell ear cups, part number 29740, modified, are installed in this model (Figure 52). The helmet and helmet bib (Figures 53, 54 and 55) integrates with the CSU-4/P, CSU-5/P, MC-3A and MC-4A coveralls. The item was delivered as part number S-895, Partial Pressure Helmet.

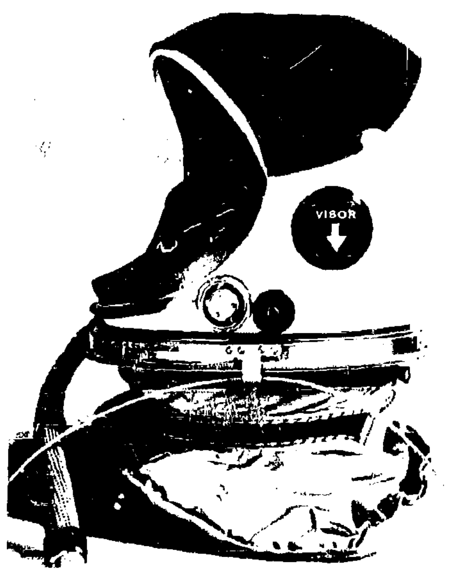

Figure 50

Valve, Mounting Helmet
P/N S-895

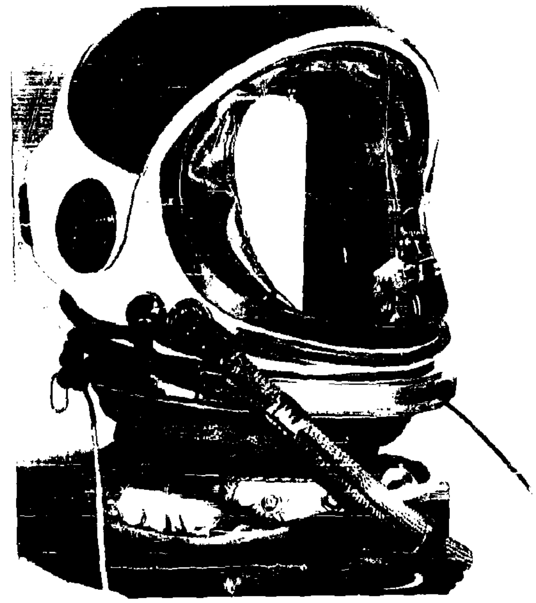

Figure 51

Communication and Pressure Lines Mounting

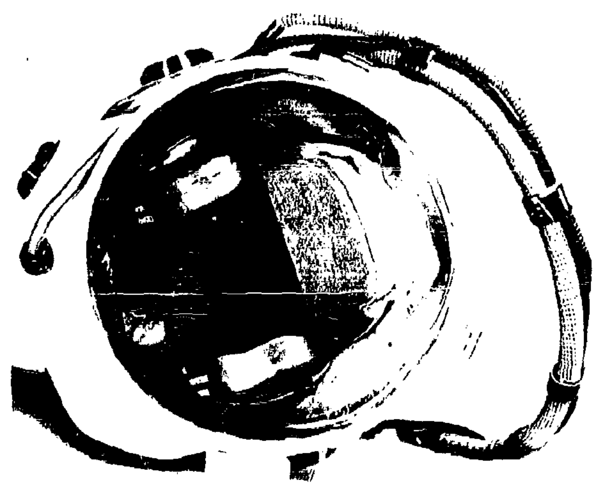

Figure 52

Face Barrier and Ear Cups

Figure 53

Front View, Helmet and Bib

Figure 54

Back View, Bib

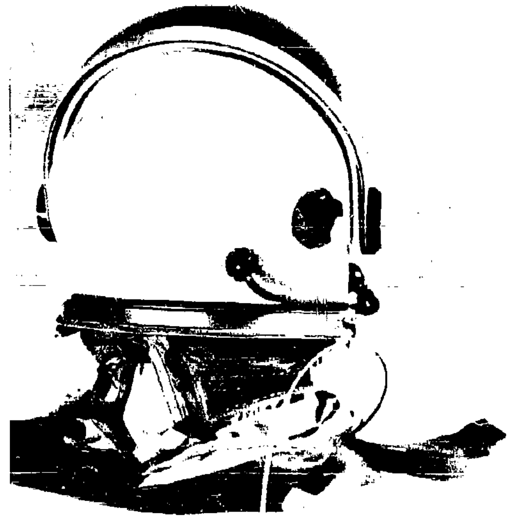

Figure 55

Back View, Helmet and Bib

B. Partial Pressure Helmet - modified

1. Through various evaluation tests, modifications were determined to be desirable, as follows:

   a. A neck seal equal to that used on the CSU-3/P Exposure Suit was used.

   b. The circumferential slide fastener was deleted and substituted by three vertical slide fasteners, which closed from top to bottom.

   c. The bulk at the seam joining the neck seal bladder to the outer cover was reduced and the bib was extended down the upper torso an additional three inches.

   d. The latest design Protection bearing disconnect was incorporated, (Figure 56). The helmet hold-down cable was attached to the lower ring disconnect in a manner that prevented detachment when the head was moved.

   e. A continuous hold-down cable arrangement with nylon pulleys in front and back was utilized to improve mobility. This hold-down assembly integrates with the CSU-4/P and CSU-5/P partial pressure suits.

   f. The use of link net fabric for restraint was deleted from the outer neck piece cover, in order to stabilize the lower ring disconnect during head movement.

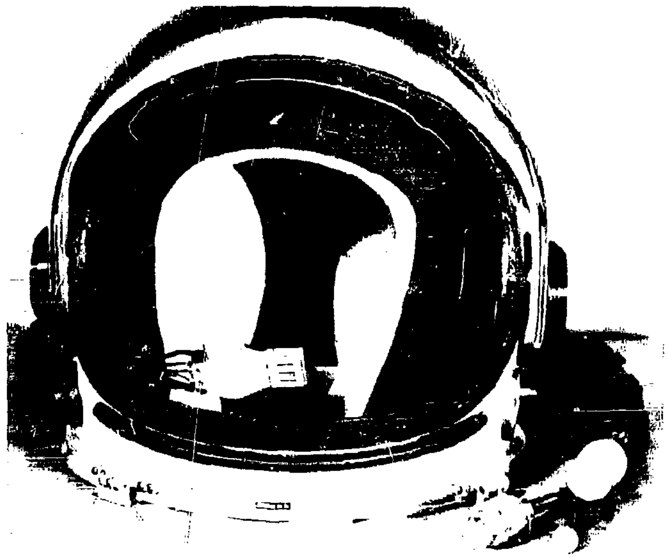

Figure 56

Helmet, P/N S-895A, with Protection Bearing

g. The ear cup/face cushion adjustment device was modified so as to reduce the thickness.

h. An aneroid operated automatic face piece closure device was designed with a provision to manually override the automatic face piece closure device. Automatic closure is positive at any angle or altitude at which the helmet is worn.

i. The oxygen bleed valve for the inflatable seal on the face piece, to permit it to override the incoming oxygen and deflate the face piece seal, has been modified and approved. The bleed valve button was modified to facilitate ease of operation and was incorporated into the face piece closure knob (Figure 57).

j. A ratchet lock provided capability for positioning the sunshade to any one of six positions, ranging from full open to full closed and included a button release mechanism for instantaneous shade deflection. Movement of the sunshade on the previous model was limited to full open or full closed, with only one intermediate stop.

k. The breathing oxygen and 70 PSI face piece seal hoses and inlet connectors were changed so as to be routed back and down over the right shoulder (Figure 58). The oxygen hose and communication cord lengths were determined, based on this change in direction, with tolerances plus or minus one inch.

l. The use of the face barrier was deleted and substituted with a chamois covered face cushion (Figure 56) which does not touch the chin area. Attachment of the face cushion frame to the helmet shell is accomplished with a light weight webbing, utilized

Figure 57

Left Side View, Face Piece Closure Knob

Figure 58

Right Rear View, Service Lines

in a four point suspension system.

m. The adjustment cord for the face cushion and ear cups is continuous so as to apply even pressure to the face and the area around the ears. The ear cups are also chamois covered. The use of a swivel mounting on the microphone was found to be unnecessary.

n. Molded keepers are employed in order to bundle the two oxygen hoses and communication cords together (Figure 59).

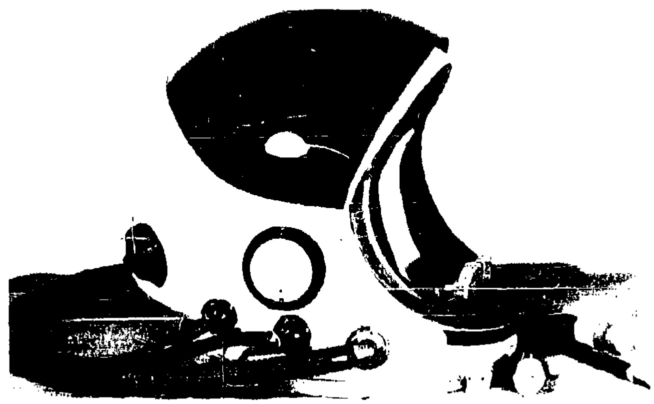

Figure 59
Right Side View, Sun Shade Knob and Face Frame Adjustment Knob

2. Two partial pressure helmets, part number S-895A, serial numbers 118 and 119, were delivered to Aeronautical Systems Division, for test and evaluation. Originally the settings were for closing at 33,000 feet and locking open at 22,000 feet. These two helmets included the following design changes and modifications, in addition to those previously outlined above:

   a. Bleed time of the visor seal was decreased by increasing the inside diameter of the orifice around the bleed pin.

   b. The aneroid setting was changed at the request of cognizant personnel from Aeronautical Systems Division, so as to lock open at 27,000 feet and close automatically at 40,000 feet.

3. The use of heated lenses was an effort to reduce fogging, icing and condensation. These are of the conductive coated variety and produce a heating capacity of .7 watts per square inch.

C. Support - In direct support of the evaluating equipment in this category, the following items were delivered:

4 each	Adaptors, part number ACS-576
2 each	Neck Seal Bladder and Suit Ring Disconnects, with liner and 37 inch hold-down cable, part number ACS-257A
4 each	Helmet Neck Ring and Disconnect Assemblies, part number ACS-262
5 each	Female Disconnects, part number ACS-568
3 each	Male Disconnects, part number ACS-567
2 each	Helmet Hold-down Cables, 40 inch, part number P-1826
1 each	Breathing Hose, 3/8 inch x 37 inches, part number P-1924
1 each	Pneumatic Seal Hose, 1/8 ID x 41 inches, part number P-1923
2 each	Aneroid Operated Actuated Valves for Lens Closing, part number P-1936