4750TH TEST SQUADRON
(TACTICS AND APPLICATION ENGINEERING)
UNITED STATES AIR FORCE
TYNDALL AIR FORCE BASE, FLORIDA

PROJECT ADC/73AD/60-11

COMPARATIVE TEST OF AIRCREW PRESSURE SUITS

1 APRIL 1961

Approved For Release 2002/11/08 : CIA-RDP75B00285R000100050002-4

TABLE OF CONTENTS

FOREWORD

This report is submitted in accordance with ADCR 55-49, dated 28 September 1959, and as directed by ADC Letter, ADOOP-T, dated 4 May 1960.

Appreciation is acknowledged to the officers and airmen of the 325th Fighter Interceptor Squadron, Truax Field, Wisconsin, whose participation and cooperation in support of this project resulted in its successful completion. Special acknowledgement is extended to the following individuals who contributed unselfishly of their time and talent to this effort:

Major Jesse R. Harrell, Jr., Physiological Training Officer, 30th Air Division, Truax Field, Wisconsin.

Captain James T. Mikulecky, Personal Equipment Officer, 325th Fighter Interceptor Squadron, Truax Field, Wisconsin - Project Officer.

TSgt Charles E. Cheek, Personal Equipment Supervisor, 4750th Test Squadron (T&AE), Tyndall AFB, Florida.

TSgt Olin E. Burkett, Personal Equipment Supervisor, 4750th Test Squadron (T&AE), Tyndall AFB, Florida.

Acknowledgement is also made to the following organizations for their services rendered in support of this project:

Directorate of Systems Engineering, Wright Air Development Division, Wright-Patterson AFB, Ohio.

USAF Climatic Laboratory, Eglin AFB, Florida.

This report is UNCLASSIFIED.

ABSTRACT

In an effort to determine which type of high altitude aircrew pressure suit best fulfilled the requirements of the Air Defense Command, Headquarters ADC directed that a comparative test be conducted on four types of pressure suits. These four types were: A/P-22S-2, A/P-22S-3 Full Pressure Suits, and CSU-4/P, CSU-5/P Partial Pressure Suits.

The A/P-22S-2 Full Pressure Suit proved to be the most acceptable garment of the four tested. This full pressure suit satisfied the prerequisites of the mission completion concept as advocated by ADC. The A/P-22S-2 suit also provided adequate aircrew protection as a land or water anti-exposure garment.

The high altitude capabilities of this garment were tested in normal and simulated emergency flight conditions. The anti-exposure features of the suit were tested in cold land and cold water environments.

It is concluded that, of the four pressure suits tested, the A/P-22S-2 Full Pressure Suit most nearly satisfies the operational requirement of ADC. Therefore, if this garment is adopted for use by ADC, it is recommended that the modifications listed in the section Conclusions and Recommendations be performed.

INTRODUCTION

Today's interceptors have the capability to seek out and destroy targets flying at the very limits of our atmosphere. To realize the full potential of our Space Defense, our aircrews must also have the capability to perform at these extreme altitudes. Therefore, the need for a high altitude space garment becomes obvious.

The MC-3/4 Partial Pressure Suit did not fulfill all of the prerequisites necessary to conform with the concept of "mission completion". For this reason, a requirement was submitted for a high altitude space garment that would provide the user with the following: (1) Protection against adverse effects resulting from a high altitude emergency, e.g., loss of cockpit pressurization. (2) Adequate comfort and mobility to complete the assigned mission in the event of such an emergency. (3) Protection from exposure in an extreme cold land or cold water environment.

As a result of the aforementioned requirement, Project ADC/73AD/60-11, Subject: Comparative Test of Aircrew Pressure Suits, was initiated. Wright Air Development Division had under development four types of pressure suits which were ready for testing. The 325th Fighter Interceptor Squadron, located at Truax Field, Wisconsin, was designated as the test support organization. Six pilots of the 325th FIS were selected as project pilots and each tested all four suits. Flight tests were conducted during day and night high altitude profile missions in the F-102 aircraft. Normal and simulated high altitude emergency flight conditions were conducted above 50,000 feet. Alert conditions, in the ready room and cockpit, were also tested. In addition, each type suit was tested in a frozen land and a cold water environment to determine their anti-exposure capabilities. Data was collected on all aspects of this test to aid in determining which suit best satisfied the requirements of ADC and was also used to establish support requirements for squadrons equipped with pressure suits.

OBJECTIVE

The objective of this test was to determine which of the four subject pressure suits best satisfied ADC requirements.

DESCRIPTION

PRESSURE SUIT MAIN DIFFERENCE TABLE

DESIGNATION	A/P 22S-2	A/P 22S-3	CSU-4/P	CSU-5/P
TYPE	Full Pressure	Full Pressure	Partial Pressure	Partial Pressure
ANTI-EXPOSURE	Integral (Dry)	Integral (Dry)	Separate Garment CWU-4/P (Wet)	Integral (Wet)
HELMET	Face Seal Type A/P 22S-2	Face Seal Type A/P 22S-3	Neck Seal Type HGU-8/P	Neck Seal Type HGU-8/P
OXYGEN REGULATOR	Helmet (Interior)	Helmet (Exterior)	Seat Kit	Seat Kit
SUIT CONTROLLER	Suit Mounted	Suit Mounted	N/A	N/A
TORSO	U-Shaped Entry Concealed Laces and Straps	Diagonal Entry External Laces and Straps	Front Entry - Zipper (Not Watertight)	
GLOVES	Suit Component Ring Attachment	Suit Component Zipper Attachment	Not Needed Except for Extended High Altitude Flights and for Protection Against Exposure.	

Approved For Release 2002/11/08 : CIA-RDP75B00285R000100050002-4

TEST RESULTS

The test results are listed under three general headings; an Operational Phase, a Support Requirement Phase, and Summary.

1. Operational Phase - This phase consisted of three tests: Flight test, ground test, and anti-exposure test.

a. Flight Test

Sorties Flown	Day	60
	Night	27
		87
Hours Flown		124:55
No. Sorties Cabin Press. Normal (Suits not pressurized)		24
No. Sorties Cabin Press. Dumped (Suits pressurized)		63
	Total	87
No. of Sorties by Suit Type	A/P-22S-2	24
	A/P-22S-3	19
	CSU-4/P	20
	CSU-5/P	24*
	Total	87

*See Summary - concerning incident on one flight in this garment.

(1) Simulated five-minute alert was conducted in each type suit.

(2) The above sorties were flown in the F-102 aircraft. These aircraft contained the F-2400 regulator modified with a 70 psi oxygen by-pass line. The GU-252 ventilating unit was installed in five aircraft and the SAAMA ventilation mod was installed in five other aircraft. All pressure sorties were flown in these ten aircraft.

(3) During the flight tests, pilots rated the suits as satisfactory or unsatisfactory under the following categories:

(a) Comfort and Mobility

(b) Aircraft Control

(c) Weapons System Control

(d) Suit Ventilation

(e) Vision

(f) Communications

(g) Suit Safety

(4) The results of each flight were tabulated and then compiled to obtain an overall standing. As the S-2 suit received the highest number of satisfactory ratings in each category, it was used as the base line for the comparative chart shown in Table 2.

b. Ground Test

(1) Five-Minute Alert - To evaluate the suits in a ready room alert environment, the project pilots simulated five-minute alert in each type garment. These alert tests lasted from five to six and one-half hours. During this time the pilots evaluated comfort and mobility features of the suit. The results of their findings are depicted in Table 1.

(2) Cockpit Alert - Simulated cockpit alert was performed in each type garment. Here again, suit comfort and mobility were the primary factors evaluated. The aircrews were fully attired in this test condition, whereas they did not wear gloves and headpiece in the five-minute alert condition. Time spent in the cockpit varied from 30 minutes to two hours. See Table 1 for comparative standings of the various garments in this test.

c. Anti-Exposure Tests - This consisted of two separate tests: Cold Land Survival and Cold Water Survival.

(1) Cold Land Survival - The Cold Land Survival Test was conducted in the Climatic Laboratory at Eglin Air Force Base, Florida. Results of this test indicated that all four suits provided adequate protection from cold land exposure when worn with the proper undergarments. See Annex A for detailed report on this test.

(2) Cold Water Survival - The Cold Water Test was conducted in Lake Superior at Duluth, Minnesota, during December 1960. This area was chosen for two reasons. First, it was conveniently located near Truax. Secondly, the mean maximum and mean minimum temperatures for the Duluth area were considered as representative for stations in the northern area. See table below:

DECEMBER

	Wurtsmith AFB	Duluth	Goose Bay
Mean Max Temp (F)	33	23 (21)	15
Mean Min Temp (F)	20	6 (10)	1
Mean Water Temp (F)	40	36 (33)	32
Mean Wind Speed	8	12 (15)	10

( ): Temperatures during this test

Results of this test showed that the S-2 and S-3 Full Pressure Suits provided a sufficient degree of protection such that an individual could survive for several hours. The 4/P and 5/P garments proved unsatisfactory as they offered the wearer almost no protection from exposure. See Annex B for a detailed account of this test.

2. Support Requirement Phase - The results of this test provide the basis for the following requirements:

a. Pressure Suits - The following pressure suit with minor modifications as listed under recommendations: A/P-22S-2 Full Pressure Suit.

b. Aircraft Modification - To accommodate the A/P-22S-2 suit, the following aircraft modifications are required:

(1) Ventilation air source for suit cooling. The GU252 aircraft vent unit proved more feasible than the SAAMA aircraft vent modification. See Figure 14.

(2) A 70 psi by-pass line on the oxygen regulator in the seat kit.

(3) Increase aircraft oxygen capacity to provide a remote base turnaround capability.

(4) Increase aperture of radar scope hood to provide better scope vision.

c. Personnel - For a sustained operation utilizing the A/P-22S-2 suit, one Personal Equipment technician per three aircrew positions is required.

d. Support Equipment - The following support equipment per squadron is required for day in, day out use:

(1) Two multi-outlet ventilation units; one in the dressing area and one in the alert room. (GSU-1/E ventilation unit is satisfactory if noise level is reduced.)

(2) One spare oxygen survival seat kit per twelve assigned UE aircraft.

(3) One suit tester.

(4) Portable ventilation units. If ventilation units are supplied as stated in (1) above and if the aircraft are modified with a full pressure ventilator, Type GU252, then there is no requirement for a portable ventilating unit. If one or both of the aforementioned requirements are not satisfied, then there would be a requirement for some number of portable vent units.

TABLE 1

Pilot Evaluation Reports

As an aid to the project pilots in their evaluation of each suit, a checklist was prepared. This list contained several categories relating to suit performance that were to be evaluated as either satisfactory or unsatisfactory. Table 1 is a compilation of the evaluation reports listed under the several categories. The figures represent the actual number of satisfactory and unsatisfactory comments.

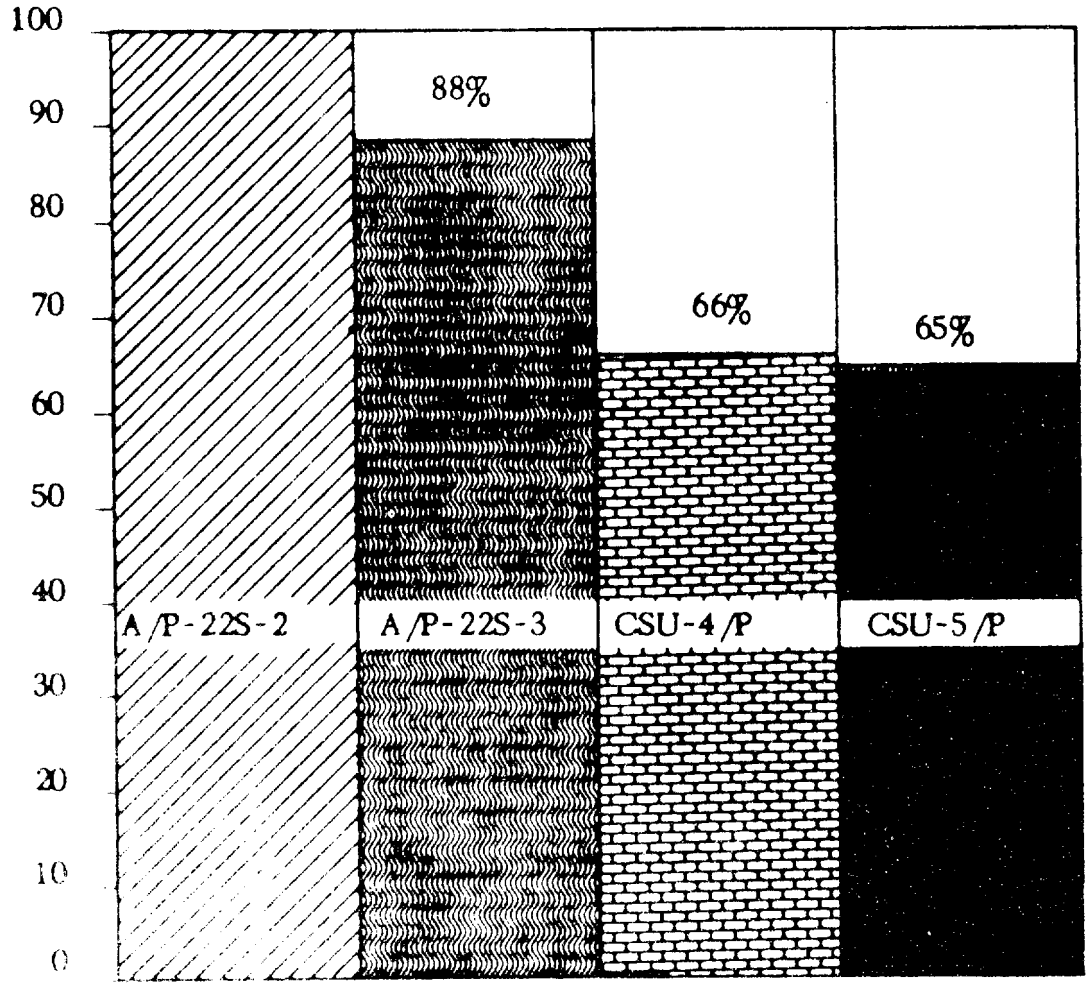
	A/P-22S-2		A/P-22S-3		CSU-4/P		CSU-5/P	
	S	U	S	U	S	U	S	U
Comfort	42		4	28	33	1	38	2
Ventilation	42		28	2	34		37	3
Mobility	42		3	29	34		40	
A/C Control	42		23	9	34		40	
Wpns System Control	42		19	9	31	3	39	1
Vision	42		32		33	1	40	
Communication	42		33		34		40	
Flight Safety/Hazard	42		32		34		39	1
Ground Comfort	12			12	12		3	9
Ground Mobility	12			12	12		11	1
TOTAL	360		174	101	291	5	327	17
Rating	100		63		98		95	

TABLE 1

TABLE 2

Overall Standings

Table 2 depicts the overall standing of the suits. These ratings were based upon suit performance and acceptability in flight, cold land environment and cold water environment. All four suits performed equally satisfactorily in the Cold Land Survival Test, hence the relative standings of the suits were not changed as a result of this test. In the Cold Water Test, the S-2 and S-3 were considered equally satisfactory; however, the 4/P and 5/P garments were completely unsatisfactory.



3. Summary - General comments on each type suit are listed below:

a. A/P-22S-2 - There were three praiseworthy features of this suit, of which all of the project pilots were unanimous in voicing their opinions. These were ease of donning, comfort and mobility.

(1) Donning - Although suit donning, per se, was not considered a factor in this test, yet the fact that every pilot commented on it, merits its mention here. A pilot can don the complete suit, less headpiece, without assistance in about five minutes.

(2) Comfort - Quite understandably, comfort plays a big role when decisions are made on items of flying attire. On this count, the S-2 suit rated high. It not only afforded comfort in flight, but on the ground as well. This garment is relatively light in weight and loose fitting, two features which reduce the fatigue factor considerably.

(3) Mobility - The mobility that this suit affords the wearer is excellent. Up to cabin altitudes of 55,000 feet, all cockpit controls, consoles, console switches, and circuit breaker panels can be reached in the F-102 aircraft. Furthermore, all these areas can be seen, with the exception of the left and right aft circuit breaker panels. Mobility is also retained in a ground environment. There is no restriction of body movement in the least, hence, the wearer may perform in a normal manner without experiencing undue fatigue.

b. A/P-22S-3

(1) Comfort and Mobility - This suit was the least comfortable and afforded the least mobility of the four garments tested. This diminished comfort and mobility may, in part, be attributed to the fact that during the original fittings, the suits were not properly adjusted. Subsequent adjustments eventually resulted in an optimum fitting; however, the comfort and mobility enjoyed in the S-3 still did not match that of the S-2. The S-3 garment did perform satisfactorily in the anti-exposure tests.

(2) Donning - One major drawback of this suit was the difficulty encountered in donning. Because of its tight fit, the user invariably scraped his head on the entrance zipper as he pulled the upper part of the suit over his head. Similar discomfort was experienced by the subject when he attempted to place the neck ring over his head.

c. CSU-4/P

(1) Comfort and Mobility - The comfort and mobility of this garment was considered excellent by all of the project pilots. All switches, consoles and cockpit controls could be reached with the suit pressurized at cabin altitudes up to 55,000 feet. One annoying feature of this suit was that it would partially inflate when the user took a deep breath.

(2) Donning - Although considered by some to be a quick don suit, this did not prove so. The lengthy zippers, and the care required to prevent clothing from catching in these zippers, precluded rapid donning of the 4/P. Donning time was further increased because trapped air in the bladders resulted in tight fitting areas.

d. CSU-5/P

(1) Comfort - This suit was somewhat less comfortable than the S-2 and 4/P primarily because it was considerably bulkier. This increase in bulk over that of the 4/P was due to the fact that the anti-exposure features were integrated into this garment, whereas the 4/P did not contain them. As with the 4/P, intermittent partial pressurization occurred during normal flight (cockpit pressurized) whenever the pilot took a deep breath. Neither aircraft ventilating system tested (Pioneer Central, Type GU252 or the SAAMA vent mod) was able to supply sufficient pressure for adequate cooling.

(2) Mobility - Suit mobility was rated as satisfactory by all project pilots.

(3) Flight Safety - This section is included here because the only flight safety incident during this test occurred while a pilot was flying in the CSU-5/P suit. The pilot was flying in a practice ILAS and extended the landing gear. As he withdrew his hand from the landing gear lever, the loop formed by the suit-to-glove bladder lead, caught the throttle and the engine was inadvertently stopcocked.

In spite of the pilot's precarious position (approximately 1,000 feet above the terrain, landing gear down, and airspeed 220 knots and decreasing!), he was able to make a successful airstart and proceeded on to base and landed. A recommended modification to the CSU-4/P and CSU-5/P garments to preclude such an event from reoccurring is to enlarge the present sleeve zipper to allow the suit-to-glove bladder lead to be tucked away. The leather covering of the glove should also be extended to cover this bladder lead.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are set forth:

4. Pressure Suit - The A/P-22S-2 Full Pressure Suit most nearly satisfies the operational requirements of the Air Defense Command. Therefore, if this garment is adopted for use by ADC, the following modifications should be performed:

a. Helmet

(1) Face Seal - Delete extra flap on face seal.

(2) Glare and Reflection - Alleviate glare and reflection on face plate.

(3) Face Plate - One-handed operation of face plate.

(4) Face Plate Seal - Warning device to indicate loss of face plate seal.

(5) Face Seal Adjustment - Face seal adjustment be independent of earphone adjustment.

(6) Earphones - Reduce thickness of earphones.

(7) Helmet Tie-Down Straps - Longer length on front tie-down.

b. Suit

(1) Suit Altimeter - Small suit mounted altimeter to be installed on left thigh of suit.

(2) Suit Controller - Smaller suit controller with "BREKO" fittings.

(3) Survival Mittens - Suit-equipped survival mittens with "O" ring seal.

c. Accessories - Following items of wear are required for issue to each assigned aircrew:

(1) Underwear - Two sets of long waffle-weave and two sets of long cotton.

(2) Alert Boot - One pair of quick donning alert boots for wear with the A/P-22S-2. This boot should be approximately one size larger than normal.

5. Aircraft Modifications - The following aircraft modifications are recommended for aircraft/pressure suit operation:

a. Ventilation Unit - The GU252 ventilation unit to provide suit cooling.

b. 70 psi By-Pass - A 70 psi by-pass line on the oxygen regulator in the seat kit.

c. Oxygen Supply - Double the oxygen capacity of all interceptors.

d. Radar Scope Hood - An increased aperture of the radar scope hood to provide better scope vision.

6. Personnel - For maximum utilization of the pressure suit during sustained operations, one Personal Equipment technician per three aircrew positions is recommended. These technicians must all be pressure suit qualified.

7. Support Equipment - The following items of support are recommended:

a. Ventilation Units - Two multi-outlet ventilation units; one in the suit donning area and one in the alert room. (GSU-1/E ventilation unit is satisfactory if noise level is reduced.)

b. Survival Seat Kit - One spare oxygen survival kit per twelve assigned aircrew positions.

c. Suit Testers - One suit tester per squadron.

d. Portable Ventilating Units - If ventilation units are supplied as stated in Paragraph a. above and if the aircraft are modified with a full pressure ventilator, Type GU252, then there is no requirement for a portable ventilating unit. If one or both of the aforementioned requirements are not satisfied, then there would be a requirement for some number of portable vent units.

8. Survival Equipment - Following cold weather equipment is recommended:

a. Combi-Suit (Walk-Around Sleeping Bag) - This garment be an item of issue for installation in the seat kit.

9. Pressure Suit Issue and Checkout

a. Pressure Suit Issue - The A/P-22S-2 Pressure Suits be issued directly to the using organizations.

b. Pressure Suit Checkout - Squadron Personal Equipment technicians be responsible for aircrew fittings and console checkouts. (Chamber flights are not necessary to checkout the garments.)

PREPARED BY:

NORMAN R. SMEDES
Captain, USAF
Project Officer

REVIEWED BY:

VERMONT GARRISON
Colonel, USAF
Commander
4750th Test Squadron (T&AE)

APPROVED BY:

JACOB W. DIXON
Colonel, USAF
Vice Commander
73rd Air Division (Weapons)

DISCUSSION

1. Pressure Suit, A/P-22S-2 - The A/P-22S-2 Full Pressure Suit was unanimously indorsed by the six project test pilots with the following modifications:

a. Helmet

(1) Face Seal - The face seal on the S-2 helmet is composed of a thin rubber seal which is attached to the main face seal. This dual seal was designed in this manner to provide a more positive seal; however, this feature proved unsatisfactory. Considerable poking and pulling was required to properly adjust the seal around the face. This awkward arrangement was time consuming and discomforting to the wearer. Furthermore, this dual face seal tended to curl and separate through continuous adjustment, allowing suit air to enter the face chamber. One helmet face seal did separate and hence, rendered the complete headpiece useless. To alleviate the aforementioned problems, it is recommended that a single face seal be designed, preferably a rubberized sponge assembly similar to that contained in the S-3 face seal.

(2) Glare and Reflection - The annoying distraction caused by face plate glare and reflection was prevelant in all types of headpieces, including the S-2. When flying on a heading which is within approximately 60 degrees of the sun, the glare of the face plate is of such intensity as to reduce visibility to the extent that radar scope interpretation is seriously compromised. Similarly, with the sun to his back, the pilot is distracted because the face plate acts as a mirror. Lowering the sun visor only partially reduces glare. These problems related to face plate glare and reflection are serious and require immediate attention.

(3) Face Plate Operation - The face seal on the S-2 headpiece was designed to operate as follows:

(a) When the oxygen was turned on, the face plate would automatically close.

(b) The oxygen would then inflate the tube that seals the visor shut.

In operation, however, the above was not the case. When the oxygen was turned on, the face plate visor would lower to within approximately one-fourth inch of the full close position. The pilot would then have to perform the following:

(c) Turn the oxygen off and raise the face plate.

(d) Turn the oxygen on using one hand and simultaneously, with the other hand, manually guide the face plate visor to the full down position.

The above was necessary to prevent inflation of the face plate seal tubes prior to closure of the face plate visor. This condition is not acceptable and should be corrected. Either this automatic feature should be foolproof or the automatic feature dropped and the principle used in the S-3 headpiece be adopted.

(4) Face Plate Seal Warning Device - There were two instances in which pilots lost the seal to the face plate. If this occurs when the suit is pressurized, it will cause a pressure drop in the headpiece. If it occurs under normal cockpit conditions, it may not be readily recognizable. Therefore, some device is required whereby the aircrew has an indication of proper face plate sealing.

(5) Face Plate Adjustment - The S-2 helmet is designed in such a manner that any adjustment of the face seal makes a corresponding adjustment in the earphones. This arrangement proved unsatisfactory as proper face seal adjustment invariably resulted in excessive pressure on the ears. This problem can be alleviated by routing the face seal adjustment straps through brackets which are mounted to the helmet and not through the earphone pads. Such an arrangement would then provide for face seal adjustments to be independent of earphone adjustments.

(6) Earphones - A common complaint expressed by the project pilots was that the earphone pads were too thick. It is suggested that these earphone cushions be of a design similar to that installed in the HGU-2/P, the MX-2088/U.

(7) Helmet Tie-Down Straps - The length of the present helmet tie-down straps are too short. These straps should be approximately eight inches longer to provide the user with sufficient leverage for helmet tie-down when the suit starts to pressurize.

b. Suit

(1) Suit Altimeter - A small, suit mounted altimeter should be installed on the left thigh of the suit. This instrument would indicate the pressure altitude of the suit. When the suit is pressurized, this altimeter would read 35,000 feet. Any deviation from this reading (plus or minus allowable tolerances) would be an immediate indication to the aircrew of a malfunction.

(2) Suit Controller - A smaller sized suit controller is needed. The inherent problems associated with a suit mounted controller (interference with parachute and shoulder straps, vulnerability to damage due to its external mounting) can be minimized by reducing the size of the controller. To obtain the greatest reliability from this unit, it should be equipped with "BREKO" fittings.

(3) Survival Mittens - As an anti-exposure feature, survival mittens are necessary. These mittens should be readily accessible for wear in the event of a water landing; preferably carried in a pocket in the S-2 garment. For optimum protection, it is recommended that the mittens have an "O" ring seal. This type of connection is used with the standard S-2 gloves, hence the gloves and mittens could be easily interchanged.

c. Accessories - The following items of wear are required by each aircrew member:

(1) Underwear - For flights in areas where the surface temperatures are below freezing, one set of Waffle Weave Long Underwear and one set of Cotton Long Underwear must be worn. To make allowances for time required in laundering, two sets of each type of underwear should be issued to the aircrew member. (Trilock patches are not required on these undergarments as that feature has been incorporated into the pressure suit.)

(2) Alert Boots - Because of the additional bulk inherent in a full pressure suit, a pair of alert boots will have to be fitted to each individual for wear with the S-2. Generally speaking, this boot will be about one size larger than the normal foot size.

2. Aircraft Modifications

a. Suit Ventilation Unit - Two types of suit ventilation units were tested in the F-102 aircraft used in this project. One unit was a SAAMA designed modification that incorporated the aircraft air-conditioning system for ventilation air. The other was the GU252 ventilation unit, manufactured by Pioneer Central, A Division of Bendix Corporation.

(1) SAAMA Ventilation Modification - This ventilation system was satisfactory, but was not recommended for two reasons. First, if the aircraft air-conditioning system became inoperative, the ventilation capability would be lost. Secondly, if the filtration process in the air-conditioning system were damaged or disrupted, then harmful engine fumes and exhaust matter would enter the suit. This could cause suit deterioration.

(2) GU252 Ventilation Unit - This unit was satisfactory and recommended for several reasons. First, it is a small, compact unit, and can be readily installed. Secondly, it is dependent, only upon the aircraft's oxygen system. Thirdly, it supplies constant temperature air for ventilation.

b. 70 psi By-Pass - Because the S-2 suit has a controller operating on 70 psi of oxygen, the regulator in the seat kit must be by-passed. This means that the F-2400 regulator must be modified with a 70 psi oxygen by-pass line.

c. Oxygen Supply - If the GU252 type ventilation unit is accepted then the oxygen capacities of all ADC interceptors should be doubled. The GU252 utilizes the aircraft's oxygen supply and ambient cockpit air for ventilation; consequently, the remote base turnaround capability of the aircraft is compromised because of the drain on the aircraft's oxygen supply. By doubling the oxygen capacity, sufficient oxygen would be available for a minimum of two flights. This would then satisfy the requirements for a remote base turnaround.

d. Radar Scope Hood - Due to the large size of the face plate on the S-2 headpiece, modification needs to be done on the radar scope hood whereby the aperture can be increased. The present size of the aperture makes it difficult to interpret scope presentations because the user is unable to get close to the scope and have proper light shielding.

3. Personnel - Squadrons equipped with the A/P-22S-2 Full Pressure Suit must be manned with Personal Equipment technicians in the ratio of one Personal Equipment technician per three assigned aircrew positions, e.g., a squadron possessing 21 F-101B aircraft would require 14 Personal Equipment technicians. These personnel should all be pressure suit qualified. This requirement is necessary because the situation could arise in which all available technicians would be called upon to assist the aircrew members in suit donning, suit pre-flight and aircraft-suit hook-up.

4. Support Equipment - Additional support required for pressure suit operations follows:

a. Ventilation Units - Two multi-outlet ventilation units are necessary; one unit in the suit donning area and one in the alert room. The GSU-1/E ventilation unit satisfies this requirement if its noise level can be reduced. This noise level could be tolerated in the dressing area, but not so in the alert room. Noise of this magnitude would so distract and fatigue aircrew members as to substantially reduce their effectiveness.

b. Survival Seat Kit - Under present procedures, a fighter interceptor squadron is not authorized spare seat kits. Therefore, if a faulty seat kit is discovered, the aircraft is grounded until the Personal Equipment Section corrects the malfunction. This problem could be alleviated if spare kits were on hand. The inoperable seat kit would be replaced with a spare and the sortie would not be lost to a ground abort. For this reason, it is recommended that the following number of spare oxygen survival seat kits be authorized: One spare per twelve assigned aircrew positions.

c. Suit Testers - One suit tester per squadron is required. One unit should suffice for sustained operations. If the tester goes out of commission, a spare should be available within each sector.

5. Pressure Suit Issue and Checkout

a. Pressure Suit Issue - The A/P-22S-2 Full Pressure Suit should be issued directly to the using organizations. This suit, unlike previous garments, is easily fitted and requires no critical adjustments. In fact, only the minimum measurements will be required to order a ready-fit suit for most aircrews; i.e., height, weight, helmet, shoe and glove size. The squadron Personal Equipment technicians can perform the aircrew fitting.

b. Pressure Suit Checkout - The aircrews can receive suit indoctrination and familiarization at squadron level. Suit checkout will consist of, first, inflating the suit on the test console to check for leaks and secure fastenings. After this check has been satisfactorily completed, the test is repeated with the aircrew member wearing the suit. Mobility and breathing checks are accomplished. When these two checks are completed, the suit is ready for flight. High altitude chamber flights are not required to checkout the suit. The above pre-flight tests accomplish the same functional checks as a chamber flight.

APPENDIX A

COLD LAND SURVIVAL TEST

ENVIRONMENT - On 15 November 1960, the Cold Land Survival Test was conducted in the All Weather Room, Climatic Laboratory at Eglin AFB, Florida. The weather conditions that existed in this room during the test consisted of four feet of snow, with several drifts over six feet. The temperature was -5°F at the start of the test, then lowered in 5° decrements approximately every 90 minutes. Six hours later, at the conclusion of the test, the temperature was -25°F. Throughout the six-hour test period a wind was blowing (generated by a large engine-driven fan). The wind speed was 5 MPH when the test subjects entered the chamber. As the temperature dropped the wind speed was increased, reaching a peak of 30 MPH shortly before the test concluded. During the last hour of this test, snow nozzles were turned on, creating a blizzard within the test room.

ATTIRE - Four pilots from the 325th FIS, assigned as test officers on this project, participated in this Cold Weather Test. Each was attired in one of the four types of garments being evaluated; the A/P-22S-2 and S-3 Full Pressure Suits and the CSU-4/P and 5/P Partial Pressure Suits. For the first entry into the chamber, each subject wore only one set of standard issue long underwear beneath his pressure suit. Also, each subject wore only one pair of wool socks with the quick don leather insulated flying boot. (One exception to the footgear was the subject in the CSU-5/P garment who wore cold weather rubber survival boots instead of the quick don leather boot.)

TEST CONDITIONS - Subjects entered the test room equipped only with those items they would have upon landing from a parachute descent; an arctic survival kit and parachute. (Only two parachutes were available to the four subjects, simulating that two were unrecoverable.) When the pilots entered the room, the temperature was -5°F with a wind speed of 5 MPH. No temperatures were taken of the subjects but a flight surgeon was present outside the chamber and observed them through portholes.

TEST RESULTS - A/P-22S-2 - Shortly after entering the cold room, subject donned wool mittens and leather shell over his pressure suit gloves. The mittens and shell were obtained from his survival kit. About two and one-half hours later subject left chamber, complaining of a backache and very cold feet. He donned a second

pair of wool socks and added the top piece of a set of long underwear. It was determined that his back trouble was caused by the fact that his pressure suit was too short in length; therefore, he donned a larger size suit, then replaced his leather flying boots with a pair of mukluks from his survival kit and re-entered the chamber. He remained inside for three and one-half hours, at which time the test concluded. During this time, the subject worked on a snow shelter with the others, nibbled his survival rations, then spent the last hour of the test in the shelter.

OBSERVATIONS - At the completion of the test this individual was in good condition. He stated that he could have remained for an indefinite period of time. The mukluks proved satisfactory and his overall mobility was good. His visor frosted over at -20° F. Subject's back was still stiff from his earlier experience in the suit that was too small. Total time in cold room was 5:20.

A/P-22S-3 - This test subject also donned his survival mittens and leather shell over the suit gloves upon entering the chamber. He walked about, worked on the shelter, and sampled his rations. After 2:15 had elapsed he left the room, complaining of cold hands and extremely cold feet. His legs and knees were also cold. Headpiece neck ring was frozen. (Room temperature at time of exit was -12° F.) Subject donned a second set of long cotton underwear, a second pair of wool socks, and replaced his quick don boots with a pair of mukluks. Re-entered the chamber and remained for 2:40 at which time the test ended. Subject spent the major portion of this time inside the shelter. While in the shelter he spent approximately one hour with the combi-suit and booties on over his pressure suit.

OBSERVATIONS - This pilot was generally cold overall when the test finished. His headpiece neck ring was frozen, preventing helmet rotation. Subject's hands were sufficiently cold to substantially impair his finger dexterity. His feet were adequately warm in the mukluks, however. He stated that he was very warm and comfortable during the time he was in the combi-suit. Total time spent in cold room was 4:55.

CSU-4/P with CWU-4/P Coveralls - Approximately 30 minutes after entering the cold room, this subject removed his pressure suit gloves and donned the nylon inserts, wool mittens, and leather shell. Subject ate some survival rations and assisted in the buildings of the snow hut. Three hours and 20 minutes after entering, he left the chamber for five minutes to relieve himself. Subject stated that he

was in good shape. Thirty minutes later, however, he left the cold room complaining of extremely cold feet and cold hands. This subject donned a second suit of long cotton underwear and added a pair of wool socks. Some condensation had drained into his neck seal, but it was of no consequence. Subject re-entered the cold room and took shelter in the snow hut. Test concluded 1:15 later.

OBSERVATIONS - Subject pilot was in fair condition. His headpiece neck ring was frozen. His feet were cold as were his hands, resulting in impaired finger dexterity. His overall mobility was satisfactory. Total time spent in cold room was 5:05.

CSU-5/P - This test subject wore a pair of rubber, cold weather survival boots instead of the leather, quick donning. As did the tester in the 4/P, he, too, replaced his suit gloves with the nylon inserts, wool mittens, and leather shell; all obtained from his arctic survival kit. Subject occupied himself by working on the shelter, sampling rations, and moving about. He left chamber after 4:10. Subject was in good condition except for coldness around neck seal. Subsequent investigation revealed that this was due to an improper helmet adjustment which allowed condensation from face plate to drain into the neck seal. Headpiece was adjusted and subject re-entered chamber and remained until the test terminated, 1:35 later.

OBSERVATIONS - This pilot was in satisfactory condition. His headpiece neck ring was frozen, restricting head movement. Subject's hands were becoming numb from inactivity and cold. His neck was cold due to tight neck seal and reoccurring effects of previous condensation draining problems. Subject's feet were in very good condition and his overall mobility was good. Total time spent in cold room was 5:45.

Combi-Suit with Booties (Walk-Around Sleeping Bag)

A brief word on this garment: One man, attired only in a Summer 505 Uniform with low quarter shoes, donned the combi-suit and remained in the cold room for 1:30 and complained only of one foot becoming cold. (This was due to a slight leak in that bootie.) During his stay in the cold room the temperature dropped from -5° to -10° F and the wind speed ranged from 5 to 10 MPH. This combi-suit is highly recommended as an article to be included in the survival kit.

SUMMARY - Following is a breakdown of time spent both in and out of the cold room:

a.	IN	OUT
A/P-22S-2	5:20	:55
A/P-22S-3	4:55	1:05
CSU-4/P	5:05	:55
CSU-5/P	5:45	:25

b. When surface temperatures below freezing are anticipated, it is recommended that:

(1) Two suits of long underwear be worn; one cotton over waffle weave.

(2) Two pair of wool socks.

c. This test verified the fact that a shelter definitely prolongs the period of time that an individual can withstand the exposure.

d. Mukluks proved very satisfactory in cold weather.

e. Quick don boots will provide sufficient warmth if they are a proper size to wear with the suit plus two pair of wool socks.

SHELTER - The shelter constructed by the test subjects consisted of snow blocks forming a semi-circular wall about three feet high and one foot thick. A parachute canopy served as a roof. The overall dimensions of this shelter were approximately eight feet in diameter and three feet high.