



NAMRL Special Report 96-3

**DEVELOPMENT AND
IMPLEMENTATION OF THE AIRCREW
MODIFIED EQUIPMENT LEADING TO
INCREASED ACCOMMODATION
(AMELIA) PROGRAM**

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ABSTRACT

Current naval aviation life support equipment (ALSS) was designed to accommodate the 5th through the 95th percentile size of the 1964 U.S. male population. Since a large portion of the present U.S. female population falls outside this range, problems occur in fitting flight clothing and ALSS for female naval aviators. This report on Aircrew Modifications Leading to Increased Accommodation describes a fleet-wide survey of all naval female pilots, flight officers, and enlisted aircrew with regard to ALSS problems. The survey response rate was 67%. ALSS fit problems in naval aviation were identified and recommendations for solving these problems were provided to the Naval Air Systems Command. The top five ALSS problem areas identified by respondents in order of importance were helmet, urine-collection devices, torso harness, survival vest, and anti-exposure coverall.

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INTRODUCTION

Aviation life support systems (ALSS) equipment protects personnel from the extreme stresses of the aviation environment. ALSS currently worn by naval aviation personnel was designed to fit the 5th through the 95th percentile size of the U.S. male population based on a 1964 anthropometric study of naval aviators (Gifford, Provost, and Lazo, 1965). Proper fitting of this equipment is essential for the protection and safety of the individual. Because of the limited number of sizes available, a correct fit has always been a problem with aviators who have anthropometric measurements at the extreme ends of the accepted limits for aviation.

When women first entered naval aviation in the 1970s, the problem of ALSS sizing became apparent as equipment designed for the male body was issued to women. Temporary solutions to correct the sizing problems have had minimal effects. Personalized custom fitting and several Navy-approved modifications to ALSS provided temporary individual fixes for some of problems. However, the majority of fit problems remained. The recent repeal of the Combat Exclusion Law (CNO, 1993) may increase the number of eligible females in combat aviation and, at the same time, multiply the number of discrepancies in ALSS fitting. While it has been known that ALSS fitting problems existed, the extent of the problems has never been documented. This report 1) describes and documents the ALSS size problems of female naval aviators, 2) prioritizes the problem areas, and 3) identifies possible solutions.

The Naval Air Systems Command (NASC) Aircrew Modification Leading to Increased Accommodation (AMELIA) program has recently examined a number of aviation-related modifications related to ALSS for female aviators. This report describes the results of a survey of female aviators that was a part of the AMELIA project. The Naval Aerospace Medical Research Laboratory (NAMRL) designed the survey, coordinated its administration, and collected and analyzed the results. The objective of the survey was to evaluate the fit characteristics of protective flight equipment and clothing in female and "hard to fit" male naval aircrew. Additionally, the problems associated with females using existing urine collection devices (UCDs) in naval aircraft were identified. The goal of this effort was to obtain data from as many individuals currently on active duty as possible within a 6-month period.

METHODS

QUESTIONNAIRE CONSTRUCTION

The individual survey was designed to gather information relating to fit problems for aviators whose physical makeup was potentially out of the design range. Questions were conceived to assess 11 ALSS problem areas: flight suit, flight jacket, survival vest, helmet, boots, gloves, anti-exposure suit, anti-exposure liner, torso harness, anti-G suit, oxygen mask. Information pertaining to problems with the use of existing urine collection devices in aircraft, or the lack of devices, was also compiled.

A 28-page survey was constructed to be administered during a personal interview by a trained interviewer. An abbreviated survey was mailed to individuals who could not be interviewed personally. The first page of both instruments (Appendix A) was designed as an information page and used to accumulate demographic data on each participant. Name and command were optional to allow the respondents' anonymity. Assurance of anonymity was provided in an effort to boost voluntary participation and increase the quality of responses. Another strategy employed to ensure participation was the promise of timely feedback of the results of the survey to NASC and the individual participants. The bottom of the first page was a tear-off return-address sheet that respondents could complete and send back to NAMRL. Participants were instructed to return this sheet separately if they desired to remain anonymous.

A separate question page (Appendix B) was constructed for each item of the ALSS that was investigated. It was included in the personal interview version only. Questions asked were standardized, as much as possible, for

each piece of equipment. Response blanks were located in outside columns to facilitate interviewer completion. Core questions were located on the left side of the page and supplemental questions, designed to elaborate on the basic problems, were on the right. Answer blanks were coded so the interviewer could easily determine whether a supplemental question was necessary.

Diagrams of all the ALSS items (Appendix C) were included in the personal interview version. The diagram page was intended to be used when answering supplemental questions. Interviewers were asked to circle and label areas corresponding to problems identified. Both versions of the survey contained an identical sheet (Appendix D) designed to aggregate data on urine-collection device (UCD) problems and acceptability of different potential solutions. Questions were asked concerning length of missions necessitating UCD use, types of UCDs used, problems encountered with use, acceptability of proposed solutions, and current methods of dealing with urine-collection problems in-flight.

A table (Appendix E) designed to allow prioritization of ALSS problems was included in the personal interview version. Respondents were asked to rank the top five problems in terms of safety, survivability, thermal concerns, and comfort. Spaces were left for respondents to add ALSS items not covered in the survey that they believed to be priority problems in each area.

A final page (Appendix F) asking respondents to discuss cockpit/crew station design problems for their aircraft type was included in both versions of the survey. Examples of problems were given, and participants were asked to complete and return the forms after their next few flights.

The abbreviated version of the survey eliminated all of the diagram pages and condensed the ALSS question pages into a one-page tabular objective answer format. A page was added for respondents to subjectively describe inadequacies with each ALSS item. The abbreviated version was devised to take into account the fact that personal face-to-face clarification could not be provided as with the interview version of the survey.

Both versions of the survey were initially tested by aviators at the Naval Air Station, Pensacola, Florida. No major problems were noted, and minor changes were incorporated in the surveys to clarify confusing questions before the surveys were sent out.

SURVEY IMPLEMENTATION

A list of all female pilots, naval flight officers (NFOs), enlisted aircrew, and student aviators was obtained from the Bureau of Naval Personnel (BUPERS). This master list was broken down into 11 regions of the world so surveys could be sent to regions with large concentrations of the target population. A representative sample of "hard-to-fit" male naval aviators was identified to determine whether sizing problems were gender-specific or stature-related. A list of male aviators was generated using a database maintained by the Naval Aerospace and Operational Medical Institute (NAOMI). The "Micro-88" system maintained by NAOMI included a data base compiled from all flight physicals dating back five years. Initially, descriptive statistics were determined for height, weight, and four anthropometric codes of all females in the data base. A search was then conducted to identify male aviators having a physical examination in the previous year and possessing height, weight, and anthropometric codes within one standard deviation of the female data.

Four female naval aerospace physiologists and one female aviation survival equipmentman were chosen as primary interviewers. A two-day training session was held with the interviewers and ALSS engineers. An instruction sheet (Appendix G) was included with each packet of survey forms. Personal interviews were conducted at most major Naval Air Stations (NASs) within the continental United States (CONUS) as well as several facilities outside CONUS. Appendix (H) contains a representation of participant locations and sites where personal interviews were conducted. Lists of names and addresses of points of contact at the NASs for their areas of responsibility were

distributed to each interviewer. Names of individuals who could not be contacted or located were returned to NAMRL. The BUPERS military locator system (MLS) was used to locate those individuals. A copy of the survey was then sent to each of them.

When completed survey forms were returned to NAMRL, the responses were coded and entered by hand into an Microsoft® EXCEL spreadsheet on a Macintosh computer. The diagram sheets were separated from the surveys. After the demographic information was collated, the diagrams and demographics were sent to the Naval Air Warfare Center-Aircraft Division (NAWCAD), Warminster, Pennsylvania, for distribution to the respective ALSS engineers. The cockpit design sheets were separated and sent to NASC. Data analysis was completed using descriptive statistical analysis tools from the software packages EXCEL and STATVIEW.

RESULTS AND DISCUSSION

The list provided by BUPERS included a total of 624 female personnel with aviation designators. Of this number, 110 were either out of the Navy or no longer on flight status. Therefore, the female population that the study began with was 514. Of those, 344 returned completed surveys, representing 67% of the surveyed female population. Only 27 of 113 (24%) surveys were received from the "hard-to-fit" male population. The respondents had a wide variety of experience; 372,027 total flight hours were reported by all 371 of the respondents. Table 1 shows the breakdown of respondents by aviation designation. The "Other" category represents female aerospace physiologists and flight surgeons who completed the survey.

Table 1. Aviation Designation of Respondents.

Aviation Designator	Female	Male
Pilot	125	11
NFO	55	4
Student	56	8
Aircrew	98	4
Other	10	0

Respondents, by aircraft type, were jet= 60 females, 4 males; helo= 90 females, 7 males, and prop= 194 females and 16 males. The prop category includes jet-transport aircraft.

Table 2 describes the survey population's age, height, and weight. Table 3 is a distribution of the weight of the female aviator by aircraft type. These data are of particular interest because ejection seat manufacturers do not rate their seats below certain weights.

AVIATION LIFE SUPPORT SYSTEMS EQUIPMENT

Due to the very small response rate of male aviators in this project, few valid comparisons can be drawn between male and female. Unless otherwise stated, the results presented here reflect only female respondents. For ease of comparison, Table 4 provides an overview of several variables for all ALSS items.

Table 2. Survey Population's Age, Height, and Weight (mean $\pm$ SD).

Characteristics	Females	Male
Age	28.00 ± 4.78	29.07 ± 5.11
Height	66.18 ± 3.18	71.39 ± 4.86
Weight	136.19 ± 14.56	177.30 ± 39.40

Table 3. Distribution of Female Aviator Weights by Aircraft Type.

Aircraft Type	Weight (mean $\pm$ SD)	Weight (minimum)	Weight (maximum)
Jet	135.57 ± 13.84	110	168
Prop	135.56 ± 15.35	103	195
Helo	138.07 ± 13.39	115	170

Helmets

Helmet fitting has always been a problem for aviators. The standard helmet shells used for fixed-wing and helicopter aircrew currently are available only in medium and large sizes. A custom-fitting capability has been available to adjust for varying head sizes and shapes, but individuals with smaller hat sizes have continually complained about helmet fit.

Twenty-two percent of the female survey participants indicated a poor fit with their current helmet; 11% of the male respondents indicated a poor helmet fit. When prioritizing ALSS problems, survey respondents rated the helmet as the top safety issue. The biggest complaints with the helmet were distracting hot spots, bulkiness, and loose fit that allowed the helmet to slide down and restrict vision. Responding to a question on desired new sizes, respondents overwhelmingly requested smaller, narrower helmets. Only 32% responded that their helmet was issued because it was their size, but 46% indicated they had been measured prior to issue. Sixty-nine percent indicated they were aware of custom-fitting capabilities, and 64% indicated they had some version of a custom fit. When data of individuals wearing custom-fitted helmets are removed, the "poor fit" percentage does not change much (25%).

Table 4. ALSS Comparisons.

Equipment	Poor Fit Indicated	Issued "Their" Size	Measured Prior to Issue	Aware of Custom Fit Capability	Have Custom Fit
Helmets	22% (25%*)	32%	46%	69%	64%
Flight Suit	13%	40%	15%	18%	<1%
Flight Jacket	29%	35%	17%	--	--
Flight Boots	7%	52%	24%	13%	<1%
Flyers Gloves	6%	55%	20%	--	--
Torso Harness	22% (34%*)	40%	70%	91%	51%
Survival Vest	22%	--	--	--	--
Anti-G Suit	0.05	36%	52%	--	--
Oxygen Masks	0.24	40%	70%	41%	2%
Anti-exposure Coverall	0.5	16%	48%	--	--
Anti-exposure Liner	0.17	33%	28%	--	--

* Percentage in parentheses reflects custom fittings subtracted from the sample.

Flight Coverall (Flight Suit)

Thirteen percent of the female respondents indicated they had a poor fit, of the flight coverall they were issued; 11% of male respondents indicated a poor fit, and all were large individuals. Custom-fitting capability exists, but long delays in the process often discourage individuals from starting the process. Flight coverall problems personify the overall female ALSS sizing concerns. Although the CWU-27/P flight coverall comes in over 40 different sizes, several factors present difficulty in females obtaining a proper fit (e.g., breast anatomy, torso length vs. hip circumference, leg and arm length). The flight coverall is made of a fire retardant (NOMEX) material and is designed to protect the aviator from in-flight fire. To be effective, the coverall must cover the legs to the boot-top (when sitting), and arms to the wrist. To accomplish these requirements, most female respondents indicated they had to compromise fit in other areas. The biggest complaints were that the knee zippers hurt because of placement, the crotch was too low (torso length too long), and urination necessitated complete removal of the coverall. New sizes requested generally fell into the category of "female proportions," which meant narrower shoulders, larger chest, shorter torso, and wider hips. Several individuals requested a "drop seat" modification, or extension of the zipper to allow urination without removal of the coverall. Forty percent indicated they had been issued their current coverall because it was their size, and only 15% indicated they were measured prior to issue. Only 18% of female respondents indicated they were aware of custom fit capability for flight coveralls, and only 1 individual indicated she was wearing a custom-fitted coverall.

Flight Jacket

Ten percent of female respondents indicated a poor fit of their flight jacket; 14% of male respondents indicated a poor fit. Custom fitting does not exist for the flight jacket. Only 36% said they were issued their size jacket, and only 15% indicated they were measured prior to issue. Thirty-seven percent indicated issue of the leather (G-1) jacket, which is not authorized for flight. The main problems reported were bulkiness and incompatibility with the survival vest (SV-2). Forty-three individuals indicated they could not fly with the jacket, on because the combined bulk of the jacket and SV-2 hindered safe flight operations. The flight jacket was listed as the number two thermal priority problem. Very few modifications were reported, and the most frequent adjustments reported were rolling up the sleeves and/or waist band. The size adjustments most frequently desired had to do with smaller, female proportioned sizes. Shorter torso length and shorter sleeves were most frequently mentioned.

Flight Boots

Seven percent of female respondents indicated they had a poor fit of their flight boots; no male respondents indicated a poor fit. Only 13% knew a custom-fit capability existed, and only 2 individuals reported wearing a custom-fitted boot (both indicated their boots fit well). Fifty-two percent indicated the boots issued were their size, but only 24% indicated having been measured prior to issue. Thirteen percent indicated they wore extra socks to adjust for the poor fit. The major complaint about the boots was that even though small sizes were in the system, it took a very long time to obtain some sizes. New sizes requested generally fell into categories of smaller and narrower.

Flyers Gloves

Only 6% of female respondents indicated they had a poor fit of their gloves; 4% of male respondents indicated a poor fit. Fifty-five percent indicated they were issued their size gloves, but only 20% said they were measured prior to issue. The biggest complaints with the glove were difficulty operating cockpit items (especially small switches and knobs) with the fingers, and fingers catching on various items in the cockpit and other ALSS. Only one individual indicated modifying her gloves (e.g., shortened fingers), and only a few individuals indicated adjusting the gloves to compensate for poor fit. The main sizing requests related to finger length. Fifteen percent requested glove sizes with shorter fingers, and 4% requested glove sizes with longer fingers.

Torso Harness

Proper fit of the torso harness is essential for proper retention in an ejection seat and for safe ejection. One of the main problems with female fit is the location of the chest strap. The chest strap will rise upon parachute opening shock. Proper fit of the harness positions the chest strap at nipple level. If the strap is located below nipple level, females risk serious injury during ejection. For this reason, most females require custom fitted harnesses that are made only at the Naval Aircraft Warfare Center, Weapons Division, China Lake (NAWC(WD) CHINA LAKE). Only 51% of all females wearing torso harnesses indicated a custom-fitted harness, and 56% of the rest indicated they knew they had a safety problem. Cost (borne by individual squadrons) is usually the reason for not getting a custom fit. When those wearing custom fits are deleted from the analysis, 34% indicated they have a poor fit of their harness; one of five males surveyed indicated a poor fit (only one custom fit was rated as poor; 55% of custom fits were rated as fits well). Forty-five percent indicated their harness was issued because it was the "closest to the actual fit," but 70% indicated they were measured prior to issue. The main requests were for smaller sizes and changes in chest strap location. Because of the problems identified, the torso harness was ranked as the top priority for ejection seat aircraft in the areas of safety, survivability, and comfort.

Integrated Torso Harness

Very few integrated torso harnesses are used by females, and no information, other than that already reported in the torso harness section, was obtained. Custom-fitted torso harnesses cannot integrate survival items (2) because of the smaller surface area.

Survival Vest (SV-2)

Twenty-two percent of female respondents indicated a poor fit of their survival vest; 17% of males indicated a poor fit. Respondents from the helicopter community indicated more problem fits (32%) than did their counterparts in the jet (15%) and prop (20%) communities. Since this item of ALSS is "one size fits all," and very few modifications and/or adjustments can be made to compensate for fit, fitting problems are understandable. Thirty-five percent indicated that modifications were made to their vest, the majority of them were shortening chest straps to make the vest smaller. The main complaints were with egress, sitting, and movement interference because of the bulk of the vest and/or the packed survival items. The flight jacket was the ALSS item mentioned most frequently as incompatible with the SV-2, because of bulk. The helicopter emergency escape device (HEEDS) and the flashlight were the two survival items listed most frequently in restrictive movement that accounted for the additional poor fits reported in the Helo community. Because of the fixed placement of survival items, modifications to make the SV-2 smaller placed survival items under the arms and in some cases behind the back. Due to these problems, the survival vest was ranked as the top one or two in priority in all communities for safety and survivability.

Anti-G Suit

Only 5% of female respondents indicated a poor fit with their anti-g suit; no males indicated a poor fit. Thirty-six percent indicated they were issued their size, and 52% said they were measured prior to issue. Not many complaints were voiced about the anti-g suit. The most frequent complaint was that the abdominal bladder is positioned too high. Twenty-six percent indicated that they had their anti-g suit modified by an aircrew survival equipmentman to take in the waist. The main requests were for smaller waist sizes and larger calf areas.

Oxygen Masks

Twenty percent of female respondents indicated a poor fit of their oxygen mask; no males indicated a poor fit. Forty percent indicated they were issued their mask because it was their size, and 70% indicated they were measured prior to issue. The major complaints were leakage and incompatibility with glasses and helmet visor. Forty-one percent of those with a poor fit knew oxygen mask custom-fitting capability existed, but only 2 individuals reported using a custom-fitted mask (one indicated a poor fit, and the other indicated a very good fit). Only 7% indicated having their oxygen mask modified, and most modifications involved adding/adjusting a nose clip. The only adjustment mentioned involved manually holding the mask against the face to get a better seal. Forty-three percent reported experiencing at least some leakage from the masks when used. The nose (33%), cheeks (10%), and chin (5%) were the areas that leakage was reported. The main size ranges requested were shorter and narrower.

Anti-exposure Coverall

Fifty percent of female respondents indicated a poor fit of their anti-exposure coverall; 33% of male respondents indicated a poor fit. Most of the suits rated were the CWU-62/P (85%), but a few CWU-59/P's and quick-don suits were also reported. Poor fits varied by aircraft community: prop 65% helicopter 48%, and jet 33%. Many female respondents in the prop community indicated the quick-don suits on their aircraft would be unusable because of the size and bulk of the suits.

Only 16% indicated the anti-exposure suit issued was their size, and 48% indicated they were measured prior to issue. The same sort of complaints seen with the flight coverall were seen with the anti-exposure coverall, only to a greater extent because of the added bulk. Respondents indicated the coverall interfered with mobility, reach, pre- and in-flight duties, and urination, and was difficult to don/doff. Twelve individuals indicated their anti-exposure coverall was incompatible with "everything" else they wore. Other complaints dealt with comfort of wrist and neck seals and that suits are hot to wear. The anti-exposure coverall had the lowest fit rating of all ALSS items at 2.0 (on a scale of 1 to 5 with 5 being the highest); most other items were rated above 3.0. Very few modifications (3%) were reported with this item. The size range requests were shorter torso, smaller, and female proportioned.

Anti-exposure Liner

Seventeen percent of female respondents indicated a poor fit of their anti-exposure liner; 33% of men responding to this question indicated a poor fit. Thirty-three percent indicated they were issued their size, and 28% said they were measured prior to issue. The main complaint with the liner was the added bulk to an already cumbersome ensemble. No modifications or adjustments to the anti-exposure liner were reported. The size ranges requested were the same as for the flight suit.

Urine Collection Devices (UCDs)

On the UCD survey sheets, 81% of the female respondents indicated a UCD would be beneficial on some flights, while 26% indicated a UCD would be beneficial on all current flights. Respondents felt the mission in which UCDs would be most beneficial were cross-countries, cargo/transport, reconnaissance, training, and vertical replenishment. The UCD benefit, by aircraft community, was prop 85%, helo 82%, and jet 74%.

Forty seven percent indicated never having used a UCD in flight. Table 5 lists the UCD types that were reported as used and the frequency of report.

Table 5. UCD Types Reported as Used and Frequency of Report.

Type of Urine Collection	Frequency Reported
Urinal/Toilet	91
Relief Tube	65
Bottle, Cup, Can	24
Piddle Pack/Bag	13
P-3 Urine Can	7
Jill's John/Lady Jane	5
Diaper	3
Self-Made	3
Porta-Potty	1

Eighty percent (248) indicated the development of a gender-specific UCD would be of benefit in their aircraft; 62% (8) of male respondents indicated this would benefit them as well. The majority of females responding

that UCD development would not be beneficial were flying aircraft with airline type toilets (e.g., C-9, E-6A) or were students who had not flown fleet missions as yet.

One of the key reasons for inclusion of the UCD sheet was to examine the acceptability of different types of off-the-shelf UCDs that might be used to solve the problem. Six types of UCDs were listed in the survey: 1) absorbent containment device (ACD) such as a diaper, 2) internal urinary collection tube (IUCT), 3) externally applied (with adhesive) collection cup and no drain (CUPND); 4) externally applied (with adhesive) collection cup with drain adapted for relief tube hook-up (CUPD), 5) relief tube/gender modified relief tube (RT), and 6) piddle pack/gender modified piddle pack (PP). The scale used to rate acceptability was 1 to 5, with 1 being the lowest level of acceptability.

Table 6 lists the type of UCDs that respondents indicated they would like to see incorporated into their aircraft or as part of issued ALSS. Many respondents indicated that unless the flight coverall and other ALSS items were modified, it would still be difficult to use any device.

Table 6. Preference for Types of UCDs Incorporated into Aircraft or Issued as Aviation Life Support Systems.

Type of Urine-Collection Device	Frequency
Gender-Modified Relief Tube	77
Improve Onboard Toilet	30
Gender-Modified Piddle Pack	14
Porta-Potty	9
Privacy	7
"She-In-All" Type	6
On Board Toilet	5
Diaper	2
Portable Personal Urinal	2

Table 7 lists the methods of dealing with the urine-collection problem respondents indicated they currently use. Some respondents listed multiple methods.

Table 7. Current Methods Used to Cope with Lack of Urine-Collection Devices or Facilities.

Method	Frequency
Voluntary Urine Retention	1
Dehydrate	80
Use Devices Present	74
Urinate Preflight	45
Emergency Landing	6
Urinate During Refueling	2
Switched Aircraft Flown	1

Listed below are summaries of all of the UCD problems and current solutions that came from specific aircraft communities.

EA-6B/A-4 Aircraft Relief Tube Device

Problems:

- » Females access
- » Unsafe to remove lower kochs for access
- » Privacy
- » Sanitation

Current solutions

- » Non-use
- » Dehydration
- » Avoid caffeine

P-3 Aircraft Urine Can and Toilet Devices

Problems:

- » Won't use - "You use, You clean"
- » Strong squadron pressure not to use toilet, bowel movements collected in plastic bags and disposed of after flight by first to use-announcement made--"broke the code"
- » Urine can is not designed for female, hole is on side of can and too high

Current solutions:

- » Urinate in cup or can, then pour into urinal
- » Avoid caffeine

C-130 Aircraft Urinal and "Honey Bucket" Devices

Problems:

- » Privacy devices located among passenger seats and privacy curtain too small
- » "You use, You clean" squadron pressure not to use devices

- » Urinal not female-compatible
- » Cargo often blocks use of honey bucket device

Current solutions:

- » Females use urinal
- » Avoid caffeine
- » Adapt

Rotary-Wing Aircraft Relief Tube Device

Problems:

- » "Use" is safety hazard for PIC
- » RT not female-compatible
- » Must remove survival gear to use, safety hazard
- » No privacy
- » Have to go back to urinate

Current solutions:

- » Hold it
- » Dehydrate
- » Land

After the data were collected and all of the interviewers debriefed, the results and recommendations for fixing ALSS fit problems were identified. Priorities for addressing ALSS problems were based on the survey responses, but were biased by the number of surveys received from the different aviation communities, severity of the identified problems, explanations of responses from the interviewers, and other pertinent information not documented on the survey forms. The most beneficial rating scale for the determination of priorities proved to be the safety/survivability/thermal/comfort scale (Appendix E). The data received were standardized for the number of participants so that each different aviation community had an equal influence in providing an adequate guideline for priorities. The priorities and recommendations given to NASC for fixing problems are listed below:

Jet

- 1) Torso Harness
- 2) Helmet
- 3) Anti-exposure Coverall
- 4) Survival Vest (SV-2)
- 5) Urine-Collection Device
- 6) Anti-G Suit

Propeller

- 1) Flight Suit
- 2) Survival Vest (SV-2)
- 3) Helmet
- 4) Urine-Collection Device
- 5) Boots

HELICOPTER

- 1) Helmet
- 2) Anti-exposure Coverall
- 3) Survival Vest (SV-2)
- 4) Flight Suit
- 5) Jacket
- 6) Urine-Collection Device

COMBINED

- 1) Helmet
- 2) Urine-Collection Device
- 3) Torso Harness
- 4) Survival Vest (SV-2)
- 5) Anti-exposure Coverall
- 6) Flight Suit
- 7) Anti-G Suit
- 8) Jacket
- 9) Boots

SUMMARY

It has been common knowledge for quite some time that female aviation personnel in the Navy have had problems with the fit of their aviation life support equipment. This survey was the first attempt to document these problems. The AMELIA survey effort received a response rate of over 67% of the known female aviation population. The above-average response rate probably resulted from the potential benefits seen in responding. However, it was not a complete poll of the entire fleet. Less encouraging was the response from the "hard-to-fit" male population that would allow us to determine if ALSS fit problems were common to all small individuals or were actually gender specific. Distinct problem areas of ALSS were identified and prioritized, and recommendations were forwarded to the Naval Air Systems Command for scrutiny. A follow-on survey effort of all naval and Marine Corps aviation personnel will be conducted over a four year period beginning in FY96 in an attempt to acquire information from the entire fleet. It will be done as part of the required quadrennial aviation physiology and water survival training for all aviators.

RECOMMENDATIONS

The following recommendations were sent to NASC as potential solutions for the problems discovered.

JET COMMUNITY

Torso Harness

The new, adjustable torso harness (PCU-56) should be expedited as early usage indicates this harness solves a number of problems. The AMSO at Training Air Wing Six, Pensacola, should be the main point of contact for this item as this is where the majority of custom-fitted torso harnesses are identified.

Helmet

The main suggestion was incorporating a smaller size shell. Others suggestions were that fitting guidelines be established and hair guidelines for female aviators be published to standardize fit procedures.

Anti-exposure Coverall

Main suggestions were the incorporation of female proportions into new sizing charts. For this item, a shorter torso, smaller (tapered) waist, and narrower shoulders are needed. More adequate relief capability (for both male and female) is also needed. A suggestion was made for issuing one larger flight suit to fit over the coverall.

Survival Vest (SV-2)

Because most females fly with a custom-fitted torso harness, they must also wear the SV-2 Survival Vest. Suggestions were made for removing/repositioning survival gear in the vests. Programs to accelerate the development of a new vest for female proportions were also suggested. A definite need exists to optimize survival item placement for smaller aviators.

UCD

The main suggestions for Jet UCDs were accessibility and concealment. Because of the amount of ALSS jet aviators must wear and potential safety concerns with lower ejection seat handle/loosening lower seat straps, using any current UCD is very difficult, for both sexes. One comment seen frequently was that ALSS needs to be modified for any UCD to be used. Concealment of a UCD is critical as some aircraft have side-by-side seating arrangements. This privacy issue complicates use of a UCD. It was recommended that a fleet assessment of "off-the-shelf" UCDs be accomplished as soon as possible to try to field something that can be used by all female aviators.

Anti-G Suit

The main suggestion for the Anti-G suit was incorporation of female proportions into sizing charts. For this item, female proportions included smaller abdominal bladders, smaller waists, and larger calf expansions.

PROPELLER COMMUNITY

Flight Suit

The main suggestion was incorporating female proportions into sizing charts. For this item, female proportions were shorter torso, smaller tapered waist, wider hips, and narrower shoulders. The other suggestions revolved around incorporation of relief capabilities for females. Some ideas passed on were drop-seat modifications, extended zippers, and a two-piece flight suit design.

Survival Vest (SV-2)

The suggestions for the SV-2 were the same as listed for the jet community. The placement of the HEED was a concern in the E-2C community.

Helmet

The same recommendations as for jet community, smaller shell size.

UCD

Most suggestions here were same as the other communities. Some additional recommendations included incorporating a flushable toilet in larger aircraft, a device that vents overboard (e.g., relief tube), and a device that chemically alters waste products.

Boots

Recommendations were to incorporate female proportions into sizing charts. For this item, female proportions were narrower heel and instep. A main concern was that smaller sizes exist, but local supplies do not stock them, and they are very hard to obtain. The recommendation was to create a central Type Commander (TYCOM) pool or pool at NAS Pensacola, from which supplies could be drawn from. Another suggestion forwarded was to investigate thermal concerns. A number of responses indicated the current boot did not insulate the feet from temperature extremes.

HELICOPTER COMMUNITY

Helmet

The problems identified for the helo helmet were similar to the other communities, and the recommendations given were also the same.

Anti-exposure Coverall

The coverall is the same as flown in other communities so the recommendations were the same.

Survival Vest (SV-2)

Placement of the HEED bottle was a big concern for this community. The recommendation was to investigate changing placement in the vest so the bottle does not impede movement, or to modify its size to accomplish this.

Flight Suit

Recommendations were given here as were the same as those for the jet community.

Flight Jacket

Recommendations for the flight jacket were to size it for female proportions. For this item, narrower shoulders, shorter torso length, and shorter sleeves are needed.

UCD

Most of the recommendations paralleled those presented for the jet community. Since helo missions tend to be longer, UCDs with a larger capacity or with the potential for multiple use may be needed. In fact, the number-two priority overall was given to urine-collection problems. The urine-collection problems for females center on the fact that very few naval aircraft have facilities/devices that women can use to urinate sanitarily. Those flying in aircraft (E-6A, C-9) with airline-type toilets, voice no concern on this issue. For most aircraft, females identified an overwhelming number of problems that would be beneficial to fix. Though the male sample was small, it was evident that they also have urine-collection problems in naval aircraft.

The urine-collection problem centered around three areas of concern:

- a) Availability of gender-specific or gender-modified UCDs.
- b) Access through ALSS (i.e., flight suit, torso harness, underwear, anti-exposure equipment) to use UCDs.
- c) Privacy.

To answer the urine-collection problem adequately, all three areas must be addressed.

Information from the urine-collection sheets was forwarded to NASC and NAWCAD to be used for both an interim and long-term effort to correct the problem. The interim fix will make "off-the-shelf" UCDs available to female aviators. Many of these devices were mentioned as already in use. The long-term effort asked for industry to propose solutions based on the survey information.

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Appendix A

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NAVAL AIRCREW SYSTEMS
TEAM



Aviation Life Support Systems
Compatibility Survey

This survey is designed to collect information on function, compatibility and fit of various items of Aviation Life Support Systems (ALSS). Of particular interest for this survey are the inputs of individuals who fall outside of the standard sizes of ALSS currently available. This survey is a very important step in identifying deficiencies in current sizes, and projecting future ALSS needs. The results will be used solely for purposes of ALSS improvements. If you would like a summary of survey results please include your current mailing address at the bottom of this page.

Name (Optional)..... 1. _____
 Rank..... 2. _____
 Designator (eg. Pilot, NFO, aircrew, FS)... 3. _____
 Date of Designation..... 4. _____
 Total Flight Hours..... 5. _____
 Type Aircraft Currently Flying..... 6. _____
 Squadron/Command (Optional)..... 7. _____
 Gender..... 8. ☐ female ☐ male
 Age..... 9. _____
 Height..... 10. _____
 Weight..... 11. _____

 Tear sheet for result feedback.

Name: _____
 Address: _____

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Appendix B

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SUMMER FLYING COVERALL (CWU-27/P)

1. _____ (eg. 32S, 42R) ☐ custom fit 2. ☐ it was my size ☐ my size was out of stock ☐ closest size to actual fit ☐ temporary issue ☐ other _____ ☐ don't know 3. ☐ yes ☐ no	1. Size currently wearing. 2. Why was this size issued? 3. Were you measured for this item prior to issue? 4. Overall, how does your flight suit fit? ☐ poorly ☐ acceptably ☐ well ☐ other _____	4a. Indicate on illustration (attached page) where fit problems occur and label with below codes: A-Tight B-Location inconvenient C-Rubs D-Binds E-Too deep F-Too long G-Too short H-Too wide I-Too loose 4b. Are any of the following hampered by the fit of your flight suit? 4c. Are you aware that a custom fit procedure exists for flight suits?
5. ☐ yes ☐ no 6. ☐ yes ☐ no 7. ☐ yes ☐ no	5. Are there occasions when the flight suit interferes with normal pre/post/in-flight duties? 6. Would a larger range of flight suit sizes give you a better fit? 7. Is your flight suit incompatible with other ALSS items?	4b. Are any of the following hampered by the fit of your flight suit? ☐ sitting _____ ☐ walking _____ ☐ ingress/egress _____ ☐ reaching cockpit items _____ ☐ donning/doffing _____ ☐ other _____ 4c. ☐ yes ☐ no 5a. Describe: _____ 6a. What changes in sizing would help? ☐ shorter ☐ longer ☐ other _____ 7a. Which ALSS items cause problems? _____ 7b. Describe problem. _____
8. ☐ yes ☐ no 9. 10. _____	8. Has your flight suit been modified to fit you better? 9. On a scale of 1-5 (1 indicating poorest fit) how would you rate the overall fit of your flight suit? 10. Describe any other problems (zipper/pocket location(s), etc.)	8a. Who performed the modification? ☐ rigger ☐ AMSO ☐ self ☐ other _____ ☐ don't know ☐ FAILSAFE Team 8b. Describe modification. _____ 8c. Did the modification improve the fit? ☐ yes ☐ no

FLIGHT JACKET

1.
☐ Cold weather (CWU-45/P)
☐ Summer Jacket (CWU-36/P)
☐ Leather (G-1)

2. _____ (eg. 42, 44)

3.
☐ it was my size
☐ my size was out of stock
☐ closest size to actual fit
☐ temporary issue
☐ other _____
☐ don't know

4.
☐ yes
☐ no

1. Which of the following jackets do you wear in the cockpit/cabin?

2. Size currently wearing.

3. Why was this size issued?

4. Were you measured for this item prior to issue?

5a. Indicate on illustration (attached page) where fit problems occur and label with below codes:

- A-Tight
 B-Location inconvenient
 C-Rubs
 D-Binds
 E-Too deep
 F-Too long
 G-Too short
 H-Too wide

5b. Are any of the following hampered by the fit of your flight jacket?

- 5b.
☐ sitting _____
☐ walking _____
☐ ingress/egress _____
☐ reaching cockpit items _____
☐ donning/doffing _____
☐ other _____

5.
☐ poorly
☐ acceptably
☐ well
☐ other _____

5. Overall, how does your flight jacket fit?
 (Fill out separate sheet if other fit problems occur with different jackets.)

6.
☐ yes
☐ no

6. Are there occasions where the flight jacket interferes with normal pre/post/in-flight duties?

6a. Describe

6a. _____

7.
☐ yes
☐ no

7. Would a larger range of flight jacket sizes give you a better fit?

7a. What changes in sizing would help?

- 7a.
☐ shorter ☐ smaller
☐ longer ☐ larger
☐ other _____

8.
☐ yes
☐ no

8. Is your flight jacket uncomfortable when worn in conjunction with other ALSS items?

8a. Which ALSS items cause problems?

8a. _____

8b. Describe problem.

8b. _____

9.
☐ yes
☐ no

9. Has your flight jacket been modified?

9a. Who performed the modification?

- 9a.
☐ rigger ☐ AMSO
☐ self ☐ don't know
☐ other _____
☐ FAILSAFE Team

9b. Describe modification.

9b. _____

9c. Did the modification improve the fit?

- 9c.
☐ yes
☐ no

10.
☐ yes
☐ no

10. Do you make any adjustments to compensate for the fit of your flight jacket?

10a. Describe adjustments.

10a. _____

11.
☐

11. On a scale of 1-5 (1 indicating poorest fit) how would you rate the overall fit of your flight jacket?

12.

12. Describe any other problems.

FLIGHT BOOTS

1. _____ (eg. 8, 8N, 9W)
☐ custom fit

1. Size currently wearing.

2.
☐ it was my size
☐ my size was out of stock
☐ closest size to actual fit
☐ temporary issue
☐ other _____
☐ don't know

2. Why was this size issued?

3.
☐ yes
☐ no

3. Were you measured for this item prior to issue?

4.
☐ poorly
☐ acceptably
☐ well
☐ other _____

4. Overall, how do your flight boots fit?

4a. Indicate on illustration (attached page) where fit problems occur and label with below codes:

A-Tight

B-Rubs

C-Binds

D-Too long

E-Too short

F-Too wide

G-Too narrow

4b. Are any of the following hampered by the fit of your flight boots?

4c. Are you aware that custom flight boots are available?

4b.

☐ walking _____

☐ ingress/egress _____

☐ reaching cockpit items _____

☐ donning/doffing _____

☐ reaching/operating foot activated controls _____

☐ other _____

4c.

☐ yes

☐ no

5.
☐ yes
☐ no

5. Are there occasions where the flight boots interfere with normal pre/post/in-flight duties?

5a. Describe:

5a. _____

6.
☐ yes
☐ no

6. Would a larger range of flight boot sizes give you a better fit?

6a. What changes in sizing would help?

6a.

☐ shorter

☐ wider

☐ longer

☐ narrower

☐ other _____

7.
☐ yes
☐ no

7. Are your flight boots incompatible with other ALSS items?

7a. Which ALSS items cause problems?

7a. _____

7b. Describe problem.

7b. _____

8.
☐ yes
☐ no

8. Have your flight boots been modified?

8a. Who performed the modification?

8a.

☐ rigger

☐ AMSO

☐ Self

☐ other _____

☐ don't know

☐ FAILSAFE Team

8b. _____

9.
☐ yes
☐ no

9. Do you make any adjustments to compensate for the fit of your boots? (eg. wear extra socks?)

8b. Describe modification.

10.

10. On a scale of 1-5 (1 indicating poorest fit) how would you rate the overall fit of your flight boots?

8c. Did the modification improve the fit?

8c.

☐ yes

☐ no

9a. Describe adjustments.

9a. _____

11.
☐ yes
☐ no

11. Have you been issued a second pair of boots for use with antiexposure gear?

11a. What size?

11a. _____

12.

12. Describe any other problems.

FLYER'S GLOVES (GS/FRP-2)

1. _____ (eg. 5, 6, 7)

- ☐ custom fit
☐ don't wear this item

2.

- ☐ it was my size
☐ my size was out of stock
☐ closest size to actual fit
☐ temporary issue
☐ other _____
☐ don't know

1. Size currently wearing.

2. Why was this size issued?

3. Were you measured for this item prior to issue?

3.

- ☐ yes
☐ no

4.

- ☐ poorly
☐ acceptably
☐ well
☐ other _____

4. Overall, how do your flight gloves fit?

4a. Indicate on illustration (attached page) where fit problems occur and label with below codes:

- A-Tight
B-Location inconvenient
C-Rubs
D-Binds
E-Too long
F-Too short

4b. Are any of the following activities hampered by the fit of your flight gloves?

4b.

- ☐ ingress/egress _____
☐ reaching cockpit items _____
☐ donning/doffing _____
☐ operating controls _____
☐ other _____

5.

- ☐ yes
☐ no

5. Are there occasions where the flight gloves interfere with normal cockpit/cabin duties?

5a. Describe:

5a. _____

6.

- ☐ yes
☐ no

6. Would a larger range of flight glove sizes give you a better fit?

6a. What changes in sizing would help?

6a.

- ☐ shorter fingers
☐ longer fingers
☐ other _____

7.

- ☐ yes
☐ no

7. Are your flight gloves uncomfortable when worn in conjunction with other ALSS items?

7a. Which ALSS items cause problems?

7a. _____

7b. Describe problem.

7b. _____

8.

- ☐ yes
☐ no

8. Have your flight gloves been modified?

8a. Who performed the modification?

8a.

- ☐ rigger
☐ AMSO
☐ self
☐ other _____
☐ don't know
☐ FAILSAFE Team

8b. Describe modification.

8b. _____

8c. Did the modification improve the fit?

8c.

- ☐ yes
☐ no

9.

- ☐ yes
☐ no

9. Do you make any adjustments to compensate for the fit of your gloves (eg. use rubber bands)?

9a. Describe adjustments.

9a. _____

10.

☐

10. On a scale of 1-5(1 indicating poorest fit) how would you rate the overall fit of your flight gloves?

11.

11. Describe any other problems.

TORSO HARNESS

1. _____ (eg. L-R, M-R)

- ☐ custom fit
☐ don't wear this item.

2.

- ☐ it was my size
☐ my size was out of stock
☐ closest size to actual fit
☐ temporary issue
☐ other _____
☐ don't know

3.

- ☐ yes
☐ no

4.

- ☐ poorly
☐ acceptably
☐ well
☐ other _____

5.

- ☐ yes
☐ no

6.

- ☐ yes
☐ no

7.

- ☐ yes
☐ no

8.

- ☐ yes
☐ no

9.

10.

1. Size currently wearing.

2. Why was this size issued?

3. Were you measured for this item prior to issue?

4. Overall, how does your torso harness fit?

5. Are there occasions where the torso harness interferes with normal pre/post/in-flight duties?

6. Would a larger range of torso harness sizes give you a better fit?

7. Is your torso harness uncomfortable when worn in conjunction with other ALSS items?

8. Has your torso harness been modified?

9. On a scale of 1-5 (1 indicating poorest fit) how would you rate the overall fit of your torso harness?

10. Describe any other problems.

1a. Is this a standard custom or a new adjustable harness?

4a. Indicate on illustration (attached page) where fit problems occur and label with below codes:

- A-Tight
B-Location inconvenient
C-Rubs
D-Binds
E-Too deep
F-Too long
G-Too short
H-Too wide

4b. Are any of the following activities hampered by the fit of your torso harness?

4c. Are you aware that a custom fit procedure exists for torso harnesses?

5a. Describe:

6a. What changes in sizing would help?

7a. Which ALSS items cause problems?

7b. Describe problem.

8a. Who performed the modification?

8b. Describe modification.

8c. Did the modification improve the fit?

1a.

- ☐ standard
☐ adjustable

4b.

- ☐ sitting _____
☐ walking _____
☐ ingress/egress _____
☐ reaching cockpit items _____
☐ donning/doffing _____
☐ other _____

4c.

- ☐ yes
☐ no

5a.

6a.

- ☐ shorter ☐ smaller
☐ longer ☐ larger
☐ other _____

7a.

7b.

8a.

- ☐ rigger ☐ AMSO
☐ self ☐ don't know
☐ other _____
☐ FAILSAFE Team

8b.

8c.

- ☐ yes
☐ no

INTEGRATED TORSO HARNESS (ACC 380)

1.
☐ yes
☐ no
☐ don't wear this item

1. Does the mounting of the survival equipment items on the harness create any problems with fit of the harness?

1a. Describe:

1a.

1b. Indicate on illustration (attached page) where fit problems occur and label with below codes:

- A-Tight
- B-Location inconvenient
- C-Rubs
- D-binds
- E-Too deep
- F-Too long
- G-Too short
- H-Too wide

1c. Are any of the following activities hampered by the fit of your torso harness?

1c.

- ☐ sitting
- ☐ walking
- ☐ ingress/egress
- ☐ reaching cockpit items
- ☐ donning
- ☐ other

2.
☐ yes
☐ no

2. Is your torso harness uncomfortable when worn in conjunction with other ALSS items?

2. Describe:

2.

3.
☐ yes
☐ no
If yes, why? _____

3. Was the incorporation of the ACC-380 or ACC-478 changed in any way from the "book"? If yes, why?

4.
☐

4. On a scale of 1-5 (1 indicating poorest fit) how would you rate the overall fit of your harness garment?

5.

5. Describe any other problems (zipper/pocket location(s), etc.)

SURVIVAL VEST (SV-2 SERIES)

1.
☐ poorly
☐ acceptably
☐ well
☐ other _____
☐ don't wear this item.

1. Overall, how does your SV-2 fit?

1a. Indicate on illustration (attached page) where fit problems occur and label with below codes:

- A-Tight
- B-Location inconvenient
- C-Rubs
- D-Binds
- E-Too long
- F-Too short

1b. Are any of the following hampered by the fit SV-2?

- 1b.
☐ sitting _____
☐ walking _____
☐ ingress/egress _____
☐ reaching cockpit items _____
☐ donning/doffing _____
☐ other _____

2.
☐ yes
☐ no

2. Is your SV-2 incompatible with other ALSS items?

2a. Which ALSS items cause problems?

2a. _____

2b. Describe problem.

2b. _____

3.
☐ yes
☐ no

3. Has your SV-2 been modified?

3a. Who performed the modification?

- 3a.
☐ rigger ☐ AMSO
☐ self ☐ don't know
☐ other _____
☐ FAILSAFE Team

3b. Describe modification.

3b. _____

3c. Did the modification improve the fit?

- 3c.
☐ yes
☐ no

4.
☐ yes
☐ no

4. Are there occasions where the SV-2 interferes with normal cockpit duties?

4a. Describe:

4a. _____

5.
☐

5. On a scale of 1-5 (1 indicating poorest fit) how would you rate the overall fit of your SV-2?

6.

6. Describe any other problems (zipper/pocket location(s), etc.).

ANTI-G SUIT

1.
☐ CSU-13B/P
☐ CSU-15/P
☐ don't wear this item

1. Which Anti-G suit were you issued?

2. _____ (SR, LXL)

2. Size currently wearing.

3.
☐ it was my size
☐ my size was out of stock
☐ closest size to actual fit
☐ temporary issue
☐ other _____
☐ don't know

3. Why was this size issued?

4.
☐ yes
☐ no

4. Were you measured for this item prior to issue?

5.
☐ poorly
☐ acceptably
☐ well
☐ other _____

5. Overall, how does your Anti-G suit fit?

5a. Indicate on illustration (attached page) where fit problems occur and label with below codes:

A-Tight
 B-Location inconvenient
 C-Rubs
 D-Binds
 F-Too deep
 F-Too long
 G-Too short
 H-Too wide

5b.

- ☐ sitting _____
☐ walking _____
☐ ingress/egress _____
☐ reaching cockpit items _____
☐ donning _____
☐ other _____

5b. Are any of the following activities hampered by the fit of your Anti-G suit?

6.
☐ yes
☐ no

6. Are there occasions where the Anti-G suit interferes with normal pre/post/in-flight duties?

6a. Describe:

6a. _____

7.
☐ yes
☐ no

7. Would a larger range of Anti-G suit sizes give you a better fit?

7a. What changes in sizing would help?

7a.

- ☐ smaller ☐ shorter
☐ larger ☐ longer
☐ other _____

8.
☐ yes
☐ no

8. Is your Anti-G suit uncomfortable when worn in conjunction with other ALSS items?

8a. Which ALSS items cause problems?

8a. _____

8b. Describe problem.

8b. _____

9.
☐ yes
☐ no

9. Has your Anti-G suit been modified to fit you better?

9a. Who performed the modification?

9a.

- ☐ rigger
☐ AMSO
☐ self
☐ other _____
☐ don't know
☐ FAILSAFE Team
 9b. _____

9b. Describe modification.

9c. Did the modification improve the fit?

9c.

- ☐ yes
☐ no

10.

10. On a scale of 1-5 (1 indicating poorest fit) how would you rate the overall fit of your Anti-G suit?

11.

11. Describe any other problems.

OXYGEN MASKS

1.
☐ MBU-5 or custom
☐ MBU-12
☐ don't know
☐ don't wear this item

2. _____ (eg. S, M, L, XL)
☐ custom fit

3.
☐ it was my size
☐ my size was out of stock
☐ closest size to actual fit
☐ temporary issue
☐ other _____
☐ don't know

4.
☐ yes
☐ no

1. What type mask are you currently wearing?

2. Size currently wearing.

3. Why was this size issued?

4. Were you measured for this item prior to issue?

5.
☐ poorly
☐ acceptably
☐ well
☐ other _____

5. Overall, how does your oxygen mask fit?

6.
☐ yes
☐ no

6. Are there leakage areas that are consistently experienced when on oxygen?

7.
☐ yes
☐ no

7. Are there occasions where the oxygen mask interferes with normal pre/post/in-flight duties?

8.
☐ yes
☐ no

8. Would a larger range of oxygen mask sizes give you a better fit?

9.
☐ yes
☐ no

9. Is your oxygen mask uncomfortable when worn in conjunction with other ALSS items?

10.
☐ yes
☐ no

10. Has your oxygen mask been modified?

11.

11. On a scale of 1-5 (1 indicating poorest fit) how would you rate the overall fit of your oxygen mask?

12. _____

12. Describe any other problems.

1a. What is the year of manufacture?

1a. _____

5a. Indicate on illustration (attached page) where fit problems occur and label with below codes:

- A-Tight
 B-Location inconvenient
 C-Rubs
 D-Binds
 E-Too deep
 F-Too long
 G-Too short
 H-Too wide
 I-Too loose
 J-Too narrow

5b. Are any of the following hampered by the fit of your oxygen mask?

- 5b.
☐ emergency egress
☐ reaching cockpit items
☐ donning/doffing
☐ other _____

5c. Are you aware that a custom fit procedure exists for oxygen masks?

- 5c.
☐ yes
☐ no

6a. Indicate on illustration (attached page) where leakage occurs.

6b. During what type of flights/flight regimes do leaks occur?

6b. _____

7a. Describe

7a. _____

8a. What changes in sizing would help?

- 8a.
☐ shorter
☐ wider
☐ other _____
☐ longer
☐ narrower

9a. Which ALSS items cause problems?

9a. _____

9b. Describe problem.

9b. _____

10a. Who performed the modification?

- 10a.
☐ rigger
☐ self
☐ other
☐ AMSO
☐ don't know
☐ FAILSAFE Team

10b. Describe modification.

10b. _____

10c. Did the modification improve the fit?

- 10c.
☐ yes
☐ no

HELMETS

1.
☐ HGU-
☐ SPH-
☐ don't wear this item

1. Which helmet are you currently wearing?

2. _____ (eg. HGU-83/84 S, M, L)

2. Shell size currently wearing.

3.
☐ it was my size
☐ my size was out of stock
☐ closest size to actual fit
☐ temporary issue
☐ other _____
☐ don't know

3. Why was this size issued?

4.
☐ yes
☐ no

4. Were you measured for this item prior to issue?

5.
☐ TPL
☐ Foam
☐ Pads
☐ Webbing
☐ Other _____

5. What type of liner is incorporated in your helmet?

6.
☐ poorly
☐ acceptably
☐ well
☐ other _____

6. Overall, how does your helmet fit?

6a. Indicate on illustration (attached page) where fit problems occur and label with below codes:

A-Tight
 B-Location inconvenient
 C-Rubs
 D-Binds
 E-Hot spots

6b. Are any of the following hampered by the fit of your helmet?

- 6b.
☐ sitting _____
☐ ingress/egress _____
☐ reaching cockpit items _____
☐ donning/doffing _____
☐ field of view _____
☐ other _____

6c. Are you aware that a custom fit procedure exists for your helmet?

- 6c.
☐ yes
☐ no

7.
☐ yes
☐ no

7. Are there occasions where the helmet interferes with normal pre/post/in-flight duties?

7a. Describe

7a. _____

8.
☐ yes
☐ no

8. Would a larger range of helmet sizes give you a better fit?

8a. What changes in sizing would help?

8.
☐ smaller ☐ larger
☐ other _____

9.
☐ yes
☐ no

9. Is your helmet uncomfortable when worn in conjunction with other ALSS items?

9a. Which ALSS items cause problems?

9a. _____

9b. Describe problem.

9b. _____

10.
☐ yes
☐ no

10. Has your helmet been modified?

10a. Who performed the modification?

- 10a.
☐ rigger ☐ AMSO
☐ self ☐ other _____
☐ don't know
☐ FAILSAFE Team

10b. Describe modification.

10b. _____

10c. Did the modification improve the fit?

- 10c.
☐ yes ☐ no

11.

☐

11. On a scale of 1-5 (1 indicating poorest fit) how would you rate the overall fit of your helmet?

12.
☐ yes
☐ no

12. Have you been issued a second helmet to be worn on specific missions?

12a. What type of missions? (Also, fill out separate helmet sheet)

12a. What type of missions? _____

ANTI-EXPOSURE COVERALL

1.
☒ CWU-62P
☐ CWU-59/P
☐ other
☐ don't wear this item

1. Which anti-exposure suit are you currently wearing?

1a. What color are the wrist & neck seals for your CWU-62/P?

- 1a.
☐ black ☐ white

1b. What color are your boots?

- 1b.
☐ green ☐ white

2.
 _____ (eg. 1, 2, 10)

2. Size currently wearing.

3. Why was this size issued?

3.
☐ it was my size
☐ my size was out of stock
☐ closest size to actual fit
☐ temporary issue
☐ other _____
☐ don't know

4. Were you measured for this item prior to issue?

4.
☐ yes
☐ no

5. Overall, how does your coverall fit?

5.
☒ poorly
☐ acceptably
☐ well
☒ other _____

5a. Indicate on illustration (attached page) where fit problems occur and label with below codes:

- A-Tight
 B-Location inconvenient
 C-Rubs
 D-Binds
 E-Too deep
 F-Too long
 G-Too short
 H-Too wide

5b. Are any of the following activities hampered by the fit of your coverall?

- 5b.
☐ sitting _____
☐ walking _____
☐ ingress/egress _____
☐ reaching cockpit items _____
☐ donning/doffing _____
☐ other _____

6. Are there occasions where the coverall interferes with normal pre/post/in-flight duties?

6.
☒ yes
☐ no

6a. Describe:

6a. _____

7. Would a larger range of coverall sizes give you a better fit?

7.
☒ yes
☐ no

7a. What changes in sizing would help?

- 7a.
☐ shorter ☐ smaller
☐ longer ☐ larger
☐ other _____

8. Is your coverall uncomfortable when worn in conjunction with other ALSS items?

8.
☒ yes
☐ no

8a. Which ALSS items cause problems?

8a. _____

8b. Describe problem.

8b. _____

9. Has your coverall been modified?

9.
☒ yes
☐ no

9a. Who performed the modification?

- 9a.
☐ rigger ☐ AMSO
☐ self ☐ don't know
☐ FAILSAFE Team
☐ other _____

10. On a scale of 1-5 (1 indicating poorest fit) how would you rate the overall fit of your coverall?

10.

9b. Describe modification.

9b. _____

9c. Did the modification improve the fit?

- 9c.
☐ yes
☐ no

11. Describe any other problems.

11.

12. What do you wear under the coverall?

12.

ANTI-EXPOSURE LINER

1.
☐ CWU-72/P
☐ CWU-23/P
☐ other _____
☐ don't wear this item.

2. _____ (eg. S,M,L or 1, 2)

3.
☐ it was my size
☐ my size was out of stock
☐ closest size to actual fit
☐ temporary issue
☐ other _____
☐ don't know

4.
☐ yes
☐ no

5.
☐ poorly
☐ acceptably
☐ well
☐ other _____

6.
☐ yes
☐ no

7.
☐ yes
☐ no

8.
☐ yes
☐ no

9.
☐ yes
☐ no

10.
☐

11. _____

1. Which liner(s) do you currently wearing?

2. Size currently wearing.

3. Why was this size issued?

4. Were you measured for this item prior to issue?

5. Overall, how does your liner fit?

6. Would a larger range of liner sizes give you a better fit?

7. Is your liner uncomfortable when worn in conjunction with other ALSS items?

8. Has your liner been modified?

9. Do you make any adjustments to compensate for the fit of your liner (eg. roll up your sleeves)?

10. On a scale of 1-10 (1 being lowest) how would you rate the overall fit of your liner?

11. Describe any other problems.

5a. Indicate on illustration (attached page) where fit problems occur and label with below codes:

- A-Tight
- B-Location inconvenient
- C-Rubs
- D-Binds
- E-Too deep
- F-Too long
- G-Too short
- H-Too wide

5b. Are any of the following activities hampered by the fit of your liner?

6a. What changes in sizing would help?

7a. Which ALSS items cause problems?

7b. Describe problem.

8a. Who performed the modification?

8b. Describe modification.

8c. Did the modification improve the fit?

9a. Describe adjustments.

- 5b.
☐ sitting _____
☐ walking _____
☐ ingress/egress _____
☐ reaching cockpit items _____
☐ donning/doffing _____
☐ other _____

- 6a.
☐ shorter _____
☐ longer _____
☐ other _____

7a. _____

 7b. _____

- 8a.
☐ rigger ☐ AMSO
☐ self ☐ don't know
☐ other _____
☐ FAILSAFE Team
 8b. _____

- 8c.
☐ yes
☐ no

9a. _____

URINE COLLECTION DEVICES

1. ☐ yes
☐ no

1. Do you fly missions where a urine collection device would be of benefit?

1a. What type of missions?

1a. _____

1b. How long are these missions?

1b. _____

2. ☐ yes
☐ no

2. Have you ever had occasion to use a urine collection device in flight?

2a. What type of device was it?

2a.
☐ on board toilet
☐ relief tube
☐ "piddle pack"
☐ absorbent containment device
☐ other: _____

2b. Describe any problems encountered while using any of devices described in 2a.

2b. Device Problem

_____	_____
_____	_____
_____	_____

3. ☐ yes
☐ no

3. Would the development of a gender specific urine collection device be of benefit in your aircraft?

4. Rate the following type of devices on an acceptability scale (ie. would you use it in the aircraft during missions)

not acceptable.....acceptable
1.....2.....3.....4.....5

4. interim long-term
 fix fix

a.	☐	☐
b.	☐	☐
c.	☐	☐
d.	☐	☐
e.	☐	☐
f.	☐	☐

a. Absorbent containment device
b. Internal urinary collection tube, catheter
c. Externally applied (with adhesive) collection cup;no drain
d. Externally applied (with adhesive) collection cup;with drain adapted for relief tube hook-up
e. Relief tube/Gender modified relief tube
f. Piddle pack/Gender modified piddle pack

5. Describe: _____

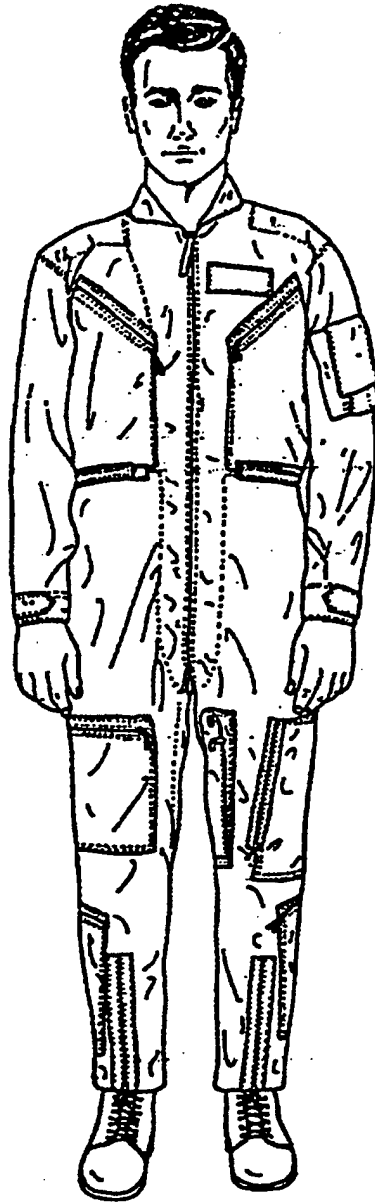
5. What type of urine collection device would you like to see incorporated into your aircraft, or as part of issued ALSS?

6. _____

6. How are you dealing with this problem now?

Appendix C

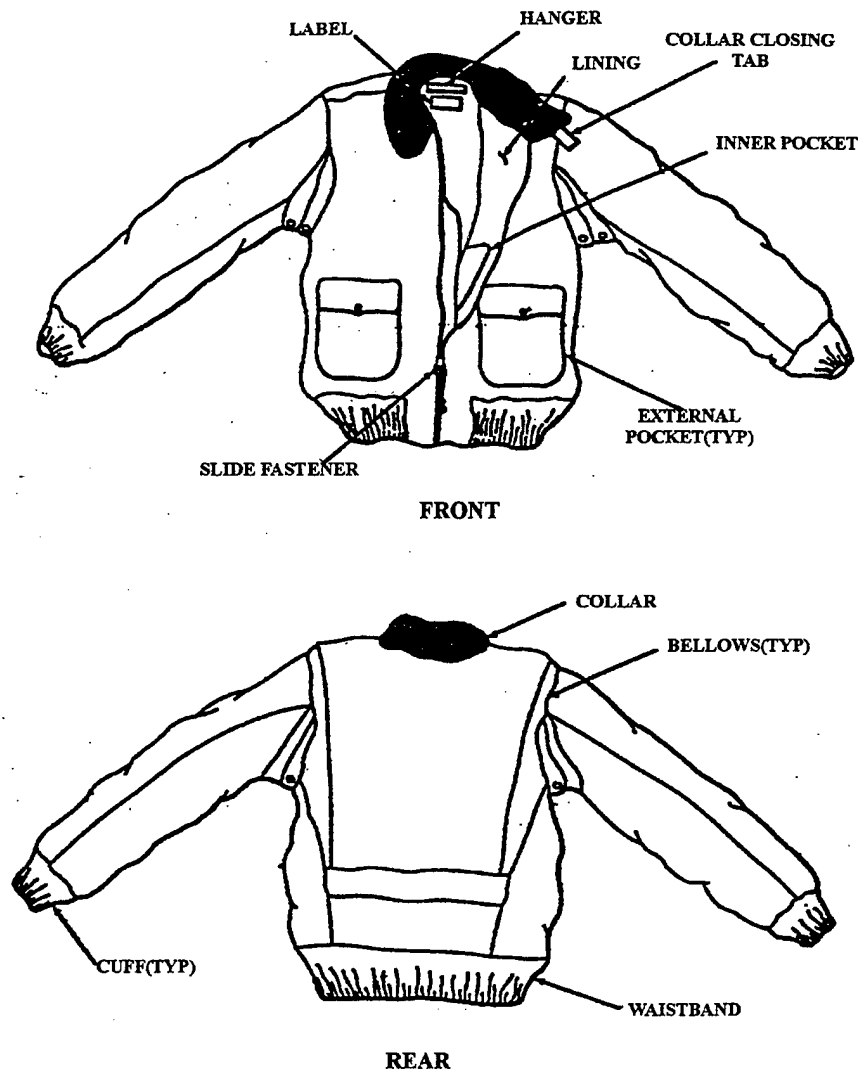
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- A-Tight
- B-Location inconvenient
- C-Rubs
- D-Binds
- E Too deep
- F-Too long
- G-Too short
- H-Too wide
- I-Too loose

CWU-27/P Summer Flyer's Coverall

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Intermediate Flyer's Jacket Nomenclature

- A-Tight
- B-Location inconvenient
- C-Rubs
- D-Binds
- E-Too deep
- F-Too long
- G-Too short
- H-Too wide

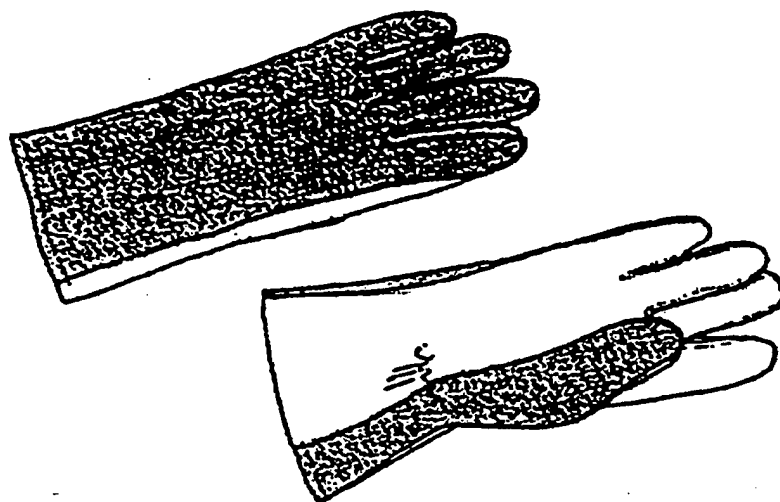
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Flyer's Boot

- A-Tight**
- B-Rubs**
- C-Binds**
- D-Too long**
- E-Too short**
- F-Too wide**
- G-Too narrow**

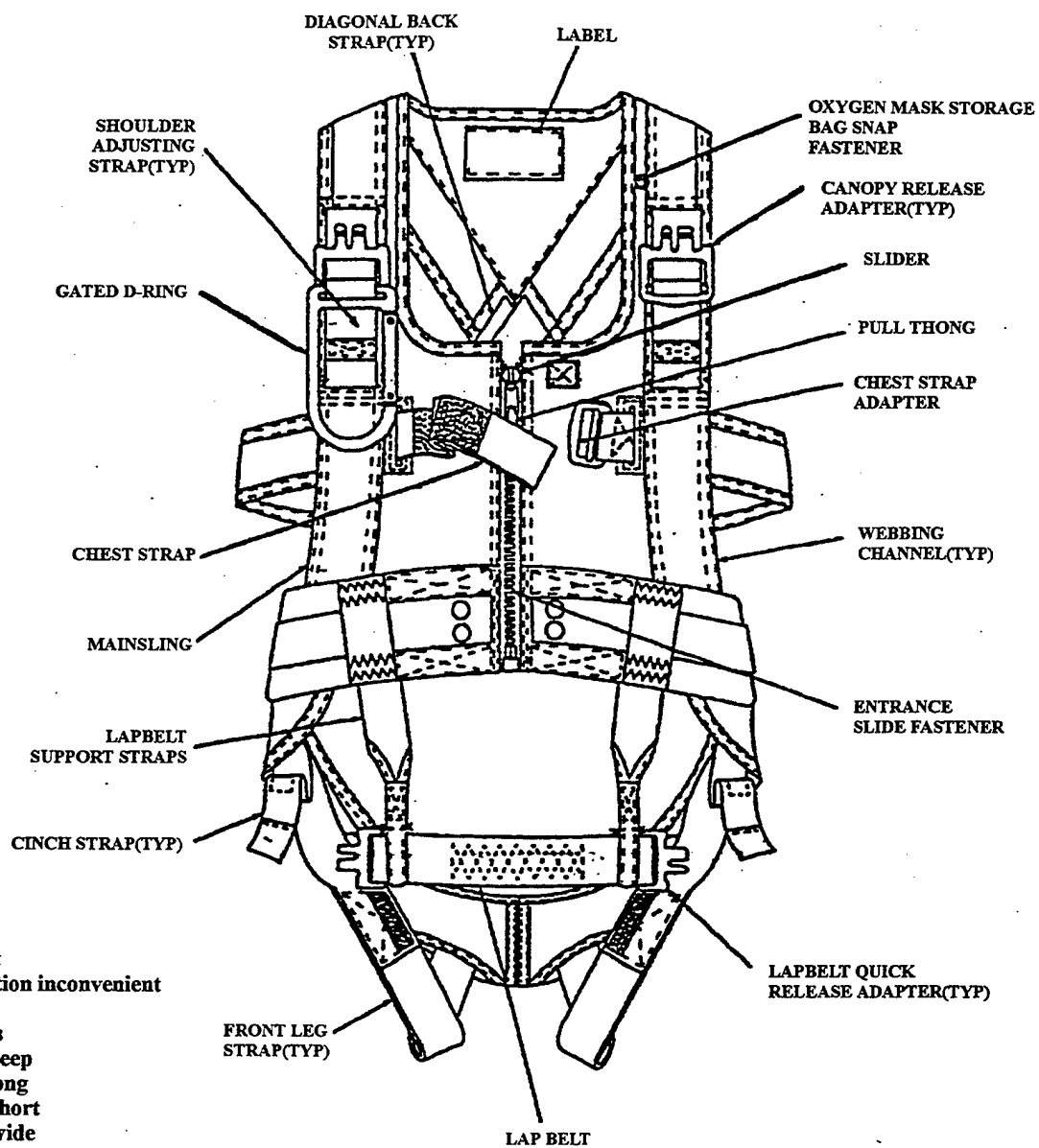
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Fire-Resistant Flyer's Gloves

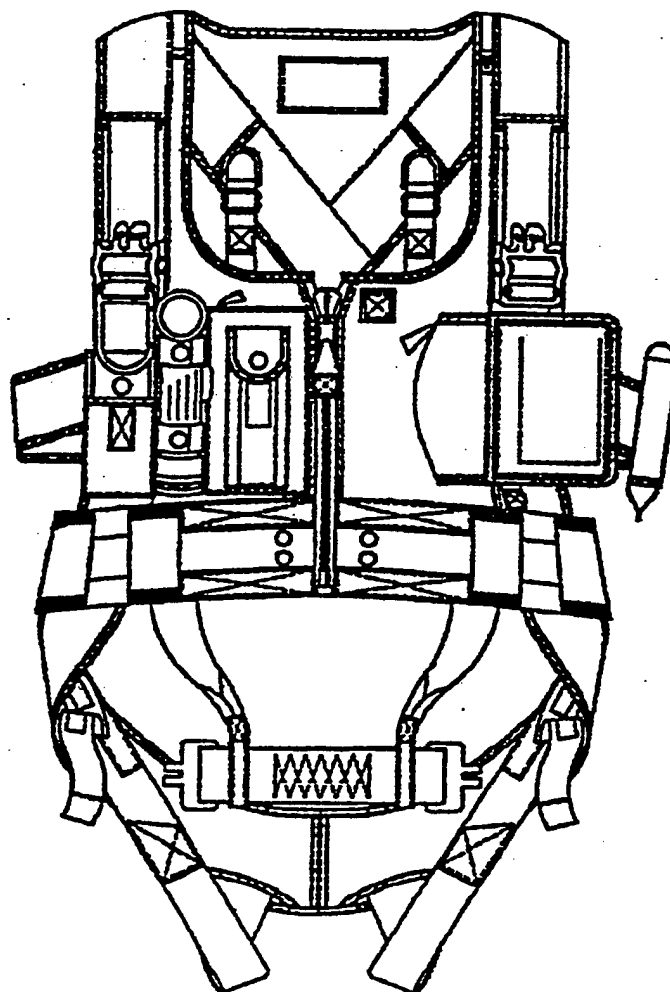
- A-Tight
- B-Location inconvenient
- C-Rubs
- D-Binds
- E-Too long
- F-Too short

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PCU-33/P, 829AS100-7 Parachute Restraint Harness Assembly

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- A-Tight
- B-Location inconvenient
- C-Rubs
- D-Binds
- E-Too deep
- F-Too long
- G-Too short
- H-Too wide

PCU-34/P, 829AS100-23 Parachute Restraint Harness Assembly
(Same as PCU-51/P, 829AS100-15 Without Flashlight)

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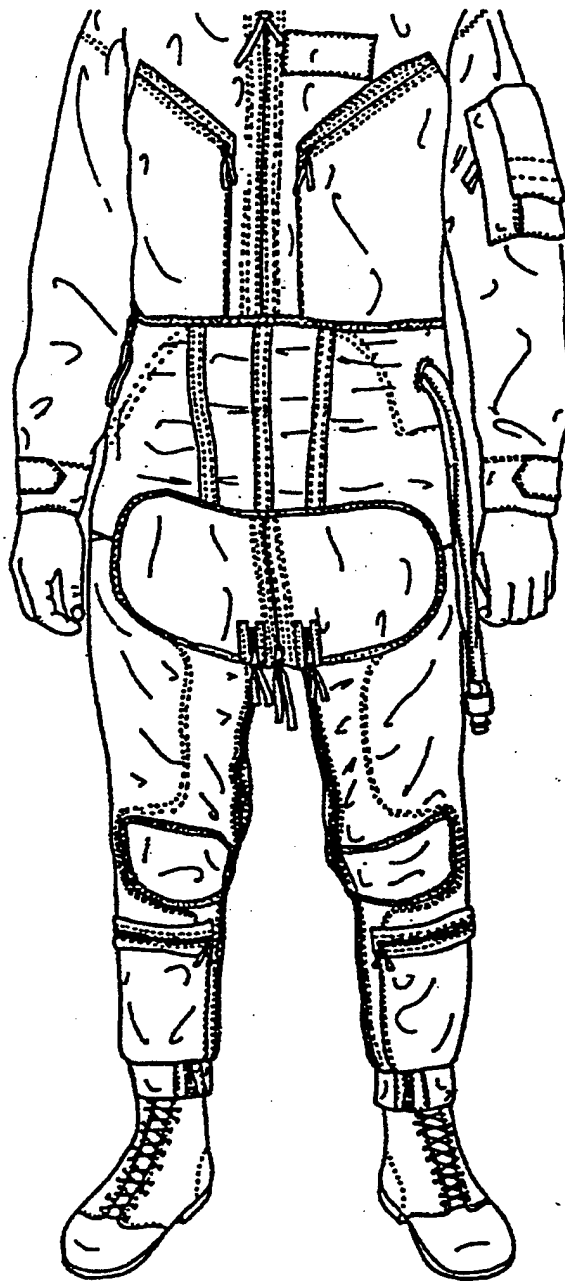
AFTER
INCORPORATION
OF ACC 436



A-Tight
B-Location inconvenient
C-Rubs
D-Binds
E-Too long
F-Too short

SV-2 Survival Vest

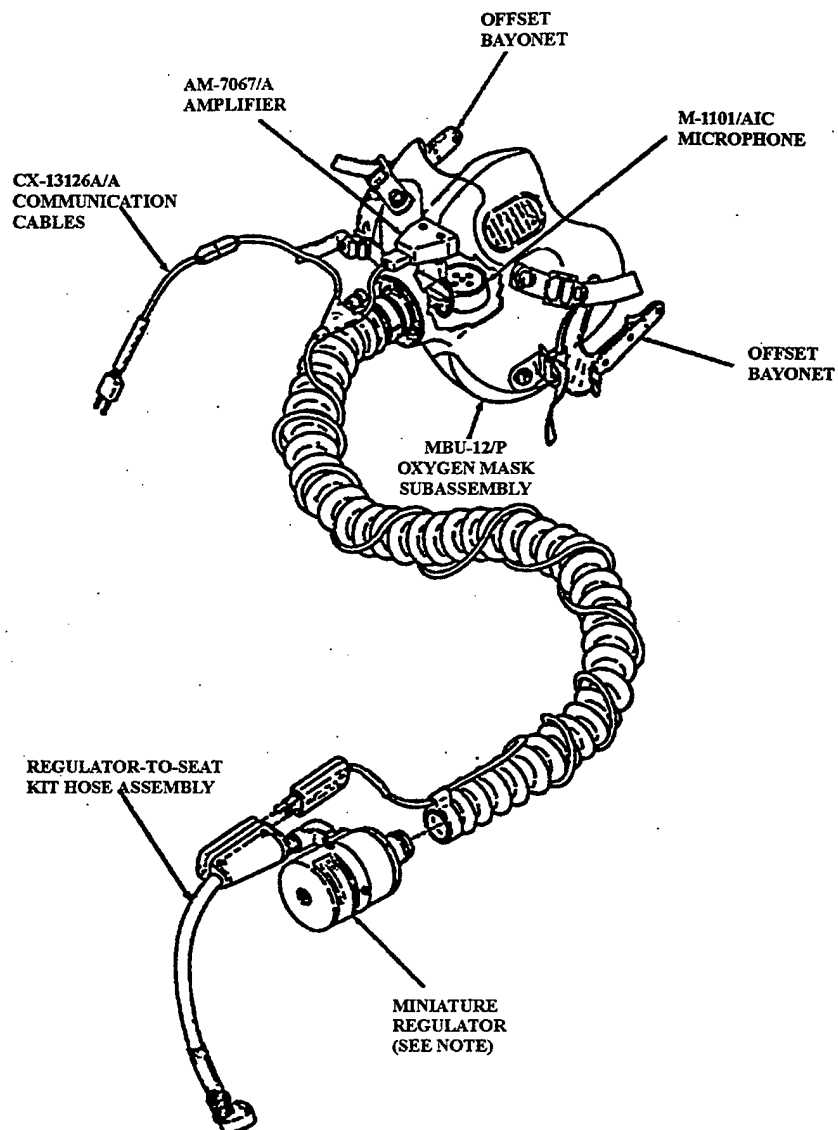
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A-Tight
B-Location inconvenient
C-Rubs
D-Binds
E-Too deep
F-Too long
G-Too short
H-Too wide

CSU-15/P Anit-g Garment

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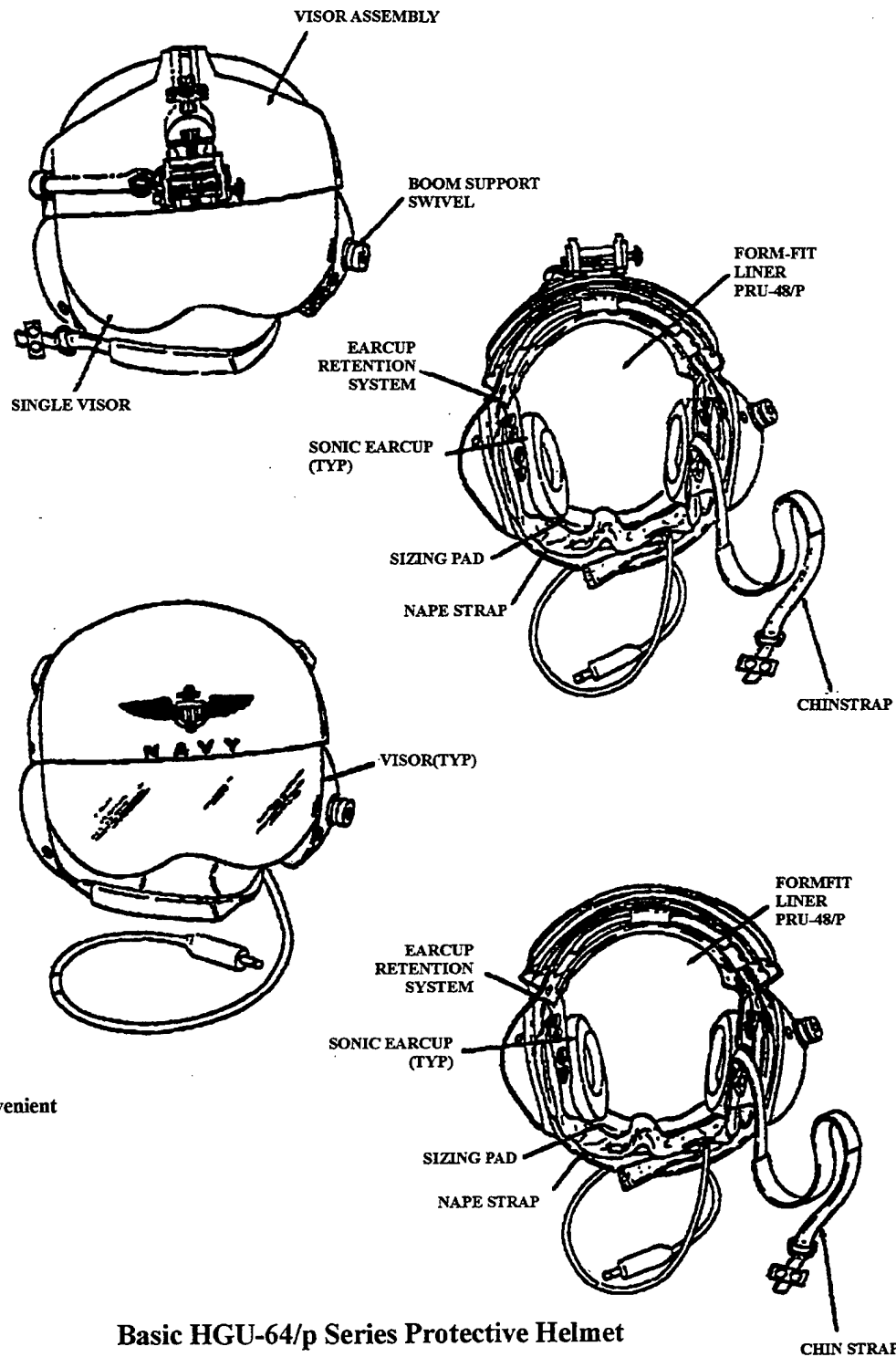


NOTE: CRU-79/P MINIATURE REGULATOR SHOWN

- A-Tight
- B-Location inconvenient
- C-Rubs
- D-Binds
- E-Too deep
- F-Too long
- G-Too short
- H-Too wide
- I-Too loose
- J-Too narrow

Oxygen Mask and Regulator Assembly

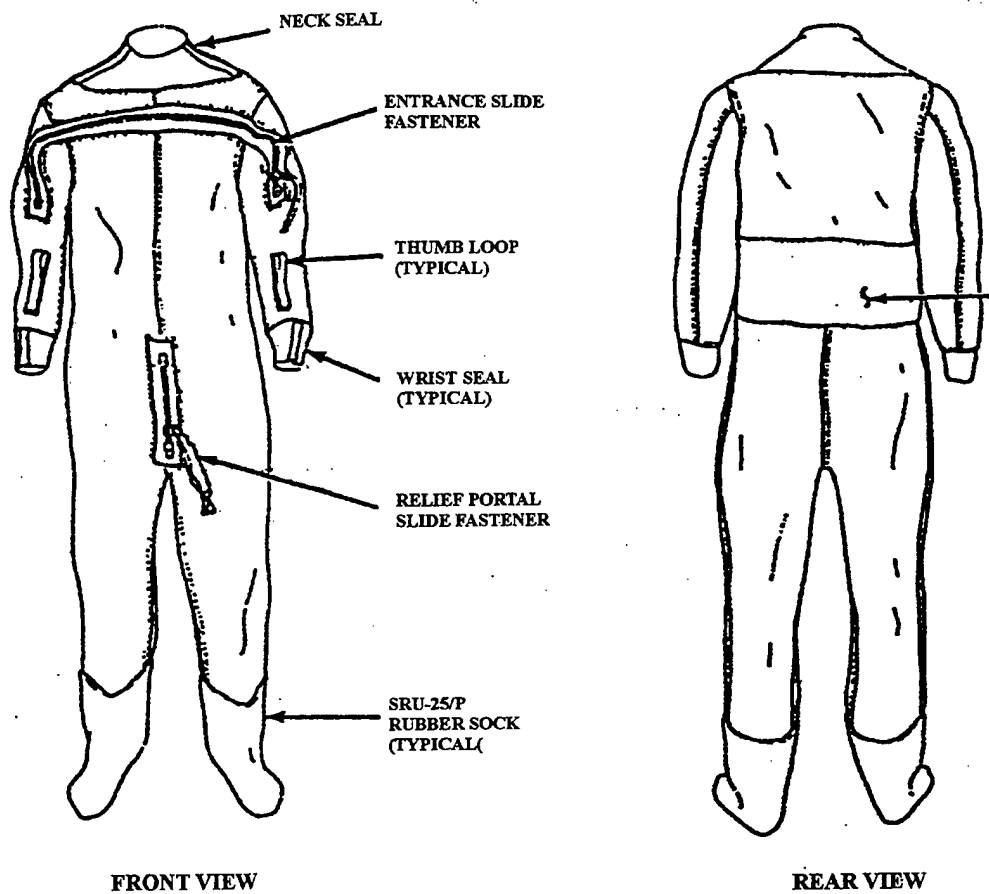
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A-Tight
 B-Location inconvenient
 C-Rubs
 D-Binds
 E-Hot spots

Basic HGU-64/p Series Protective Helmet

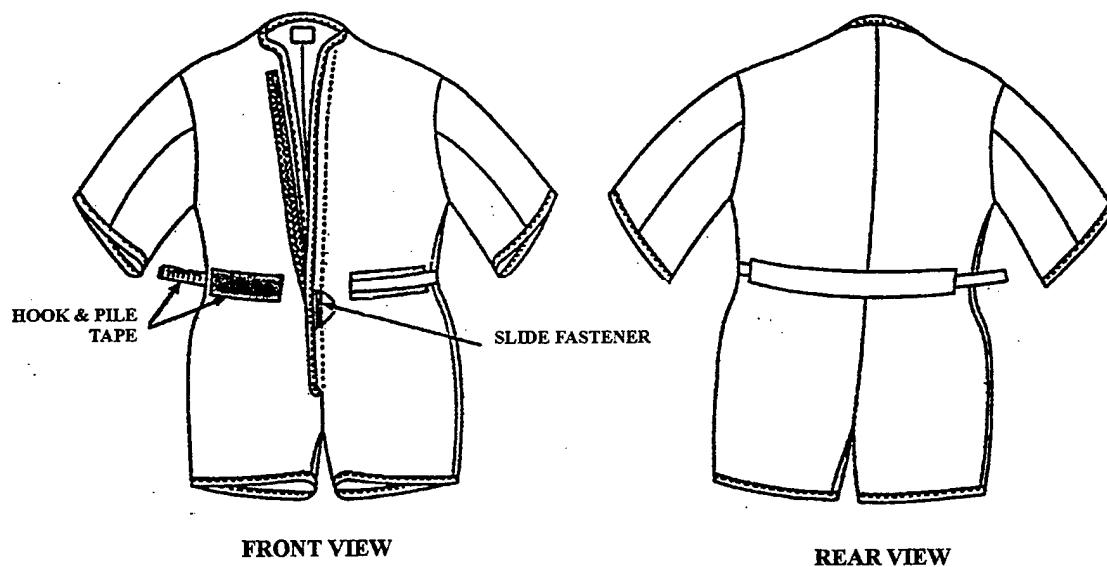
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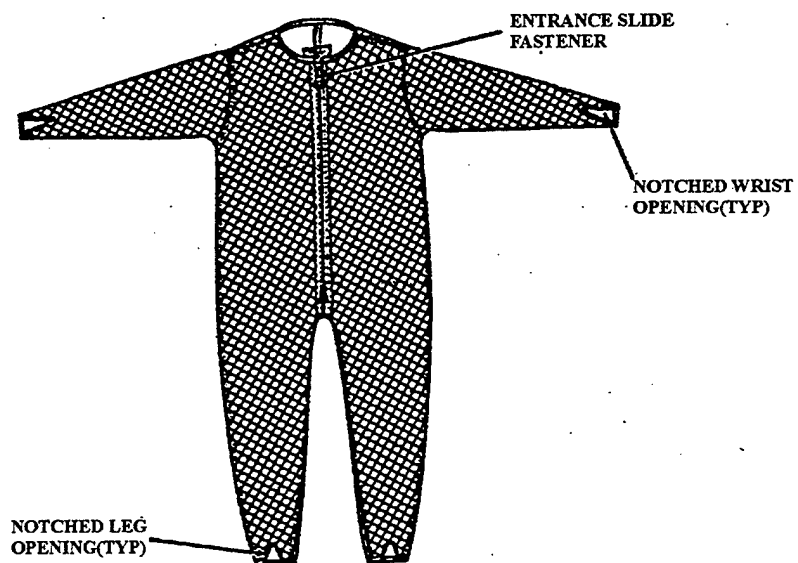
CWU-62/P Anti-Exposure Coverall

- A-Tight
- B-Location inconvenient
- C-Rubs
- D-Binds
- E-Too deep
- F-Too long
- G-Too short
- H-Too wide

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CWU-72/P LINER



CWU-23/P LINER

- A-Tight
- B-Location inconvenient
- C-Rubs
- D-Binds
- E-Too deep
- F-Too long
- G-Too short
- H-Too wide

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Appendix D

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URINE COLLECTION DEVICES

1. ☐ yes
☐ no

2. ☐ yes
☐ no

3. ☐ yes
☐ no

1. Do you fly missions where a urine collection device would be of benefit?

2. Have you ever had occasion to use a urine collection device in flight?

3. Would the development of a gender specific urine collection device be of benefit in your aircraft?

4. Rate the following type of devices on an acceptability scale (ie. would you use it in the aircraft during missions)

1a. What type of missions?

1b. How long are these missions?

2a. What type of device was it?

2b. Describe any problems encountered while using any of devices described in 2a

1a. _____

1b. _____

2a.
☐ on board toilet
☐ relief tube
☐ "piddle pack"
☐ absorbent containment device
☐ other: _____

Device	Problem
_____	_____
_____	_____
_____	_____

4. ☐ interim ☐ long-term
fix fix

a. ☐ ☐

b. ☐ ☐

c. ☐ ☐

d. ☐ ☐

e. ☐ ☐

f. ☐ ☐

5. Describe: _____

6. _____

not acceptable.....acceptable
1.....2.....3.....4.....5

a. Absorbent containment device

b. Internal urinary collection tube, catheter

c. Externally applied (with adhesive) collection cup;no drain

d. Externally applied (with adhesive) collection cup;with drain adapted for relief tube hook-up

e. Relief tube/Gender modified relief tube

f. Piddle pack/Gender modified piddle pack

5. What type of urine collection device would you like to see incorporated into your aircraft, or as part of issued ALSS?

6. How are you dealing with this problem now?

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Appendix E

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Prioritization of ALSS Problems

Prioritize the problems you have with the ALSS items discussed in this survey on the basis of safety, survivability, thermal protection, and comfort. Place numbers 1-5 in each column corresponding to the top five problem items (1 being highest priority needing attention).

	SAFETY	SURVIVABILITY	THERMAL	COMFORT
FLIGHT SUIT				
FLIGHT JACKET				
HELMET				
ANTI-G SUIT				
GLOVES				
BOOTS				
ANTI-EXPOSURE COVERALL				
ANTI-EXPOSURE LINER				
OXYGEN MASK				
TORSO HARNESS				
INTEGRATED TORSO				
SURVIVAL VEST				
URINE COLLECTION DEVICE				
Other: _____				
Other: _____				
Other: _____				

Comments:

1. Have you contacted your local AMSO about fit problems? Have they been helpful? Why/why not?

2. Has the FAILSAFE Tiger Team helped you with your fit problems? How?

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Appendix F

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COCKPIT/CREWSTATION DESIGN PROBLEMS

We would like you to give us some feedback on problems you may be having regarding cockpit/crewstation design. Please take this sheet with you and think about any problems you may have, during your next few flights due to the way your cockpit/crewstation is designed. Examples of these type of problems would be: reaching something while strapped in; physically turning a switch, pulling a handle, raising a seat, etc.; seeing something inside or outside the aircraft; or any other problems that would necessitate a redesign as a fix. (Comments for this section need not be restricted to the current aircraft you fly)

Your input here is vital if future aircraft are to be designed to accommodate a wider range of aviators. Please return this sheet to the individual conducting the interview, or mail back in the envelope provided.

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Appendix G

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AMSO NOTES: AMELIA SURVEY

Thanks for all your efforts on this program. The following are just a few notes on conducting the personal interviews. Most of this is just reminders of what was covered in Warminster. Remember, what we've listed here are optimal conditions for the interview, but realize that optimal will not always be possible. Be flexible in meeting survey goals; use your own judgment in deviating from the optimal conditions so as to obtain the best information possible.

General Guidelines

- We'd like to have as many listed individuals located in your area, interviewed as possible. The goal for completion of all surveys is 31 May 93.
- Annotate any individuals you cannot locate, are not on flight status any longer, have not been issued any ALSS, are not available for interview, or any other reasons for not being interviewed.
- Let us know as soon as possible if individuals are on dets or otherwise not close enough to interview, so we can send a mail-out version of the survey to them.
- Mail completed surveys back to NAMRL (Commanding Officer, Code 23, NAVAEROMEDRSCHLAB, 51 Hovey Rd., Pensacola, FL 32508-1046). Don't wait till they're all completed; send them back in groups of 10 or so as they are completed.
- You are not expected to conduct a fitting clinic during each interview. You need to discuss proper fit only if individual is unsure if they have a good fit.

What to bring

For best information collection the individuals should have with them:

- Their own flight gear
- NATOPS Manual (for ANTHRO Codes)
- Flight gear history record (from Sqd. PR)

Information Sheet

- Have individual read introduction and fill out information on this sheet - Remember, Name & Squadron are optional.
- Indicate Anthropometric codes (if available) just below WEIGHT space.

- If individual would like us to mail a summary of survey results have them complete the address label at bottom of page and tear/cut it off. Keep all these labels together and send them back to us.

General Information on Individual Pages

- Questions are in columns 2 & 3, answer blanks are in columns 1 & 4. Pages are designed so unnecessary questions may be skipped.
 - If individual does not use a piece of ALSS the sheet may be skipped completely.
 - If individual has no problems with the piece of ALSS only questions in column 2 need be answered.
 - If an answer in column 1 is checked in a "▲" block, this indicates the corresponding questions column 3 need to be asked. If no "▲" are checked, questions in column 3 may be skipped.
 - Questions with supplemental questions are blocked only to visually group them to ensure all needed are asked.
 - If more space is required for answers, use the back side of that page and indicate the specific answer being continued (e.g. "7b").
- Illustration pages should be completed if "▲" in appropriate fit questions has been checked. Circle areas that present problems, label each circle with appropriate letter code, and amplify if necessary.

Specific Pages

- Refer to AMELIA fitting guide for specifics on what to look for.
- Fill out extra helmet sheets if an individual wears more than one helmet.
- Fill out extra sheets for other ALSS items only if individual wears more than one of that item and has problems with the second item.
- If an individual wears an integrated torso harness you need to fill out the sheet on "Torso harness" as well. The Torso harness sheet addresses fit of harness, where the Integrated Torso sheet and the SV-2 sheet address problems with addition of survival items outside of the torso harness.
- ANTI-G suit; Add question #12 --- "Do you wear the same size in the winter as in summer?" If yes list the other size worn.

- ANTI-exposure coverall; Add question #2.1 --- "Were the booties issued to you your normal shoe size, or were they a different size?" If different, list size of booties.
- Page 27; individual should rank top five problems for each of four categories. If other pieces of ALSS are not listed, but perceived as top problems, they can be added in "other" spaces and ranked accordingly.

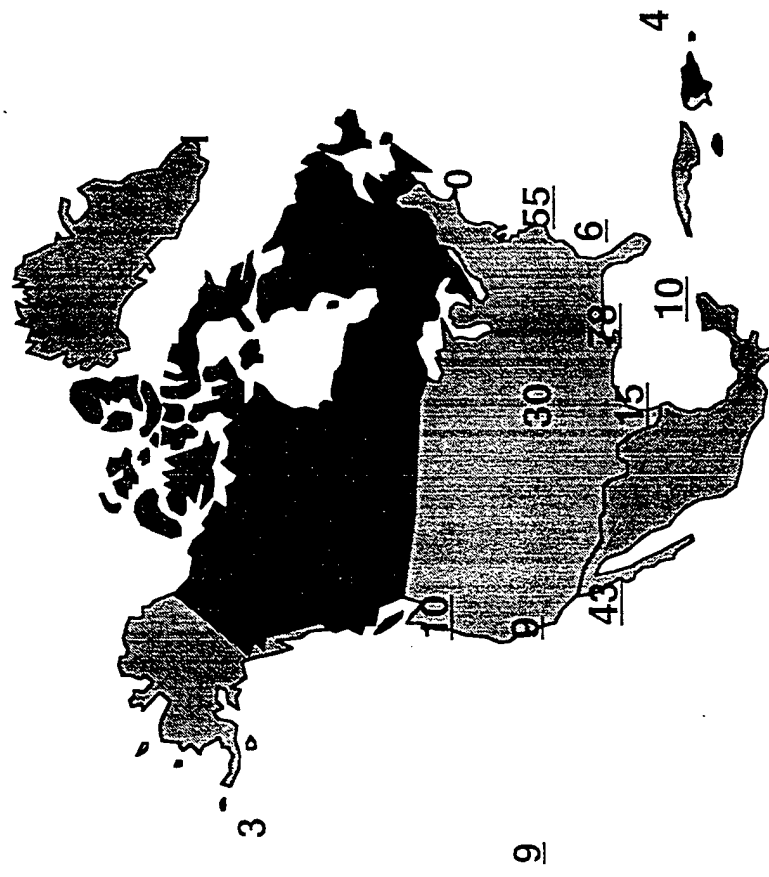
COCKPIT/CREWSTATION Design Problems; Page 28. This page is designed to be pulled off the survey and given to the individual. They should be told to think about things they perceive as problems with the cockpit/crewstation they currently fly in. After a couple flights they should complete this form and either return it to you or mail it back to NAMRL in one of the envelopes provided.

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Appendix H

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AMSO COVERAGE



*** DOES NOT INCLUDE SURVEYS WITH NO COMMAND ANNOTATED
INTERVIEWS CONDUCTED AT SITES UNDERLINED

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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.				
1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 7 October 1996		3. REPORT TYPE AND DATES COVERED Interim 1994 - 1996
4. TITLE AND SUBTITLE Development and Implementation of the Aircrew Modified Equipment Leading to Increased Accommodation (AMELIA) Program			5. FUNDING NUMBERS NAVAIR 60426NW0606000	
6. AUTHOR(S) L. G. Meyer, T. L. Pokorski, D. G. Smith,, and B. E. Ortel				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Aerospace Medical Research Laboratory 51 Hovey Road Pensacola, FL 32508-1046			8. PERFORMING ORGANIZATION REPORT NUMBER NAMRL Special Report 96-3	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Naval Air Systems Command 1421 Jefferson Davis Highway Arlington, VA 22243-0901			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) Current naval aviation life support equipment (ALSS) was designed to accommodate the 5th through the 95th percentile size of the 1964 U. S. male population. Since a large portion of the present U. S. female population falls outside this range, problems occur in fitting flight clothing and ALSS for female naval aviators. This report on Aircrew Modifications Leading to Increased Accommodation describes a fleet-wide survey of all naval female pilots, flight officers, and enlisted aircrew with regard to ALSS problems. The survey response rate was 67%, ALSS fit problems in naval aviation were identified and recommendations for solving these problems were provided to the Naval Air Systems Command. The top five ALSS problems areas identified in order of importance were: helmet, urine collection devices, torso harness, survival vest, and anti-exposure coverall.				
14. SUBJECT TERMS Aviation, Life Support Systems, Women, Accommodation			15. NUMBER OF PAGES 87	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT SAR	