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TECHNICAL REPORT
NATICK/TR-97/017

AD_____

COMPATIBILITY OF ARMY SYSTEMS WITH ANTHROPOMETRIC CHARACTERISTICS OF FEMALE SOLDIERS

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September 1997

FINAL REPORT
January 1995 - September 1996

DTIC QUALITY INSPECTED 4

Approved for Public Release; Distribution Unlimited

UNITED STATES ARMY SOLDIER SYSTEMS COMMAND
NATICK RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
NATICK, MASSACHUSETTS 01760-5020
SCIENCE AND TECHNOLOGY DIRECTORATE

19970929 114

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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
September 1997

3. REPORT TYPE AND DATES COVERED
FINAL Jan 1995 - Sept 1996

4. TITLE AND SUBTITLE
COMPATIBILITY OF ARMY SYSTEMS WITH ANTHROPOMETRIC CHARACTERISTICS OF FEMALE SOLDIERS

5. FUNDING NUMBERS
DAAK-93-D-0005

6. AUTHOR(S)
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7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
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8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Soldier Systems Command,
Natick Research, Development and
Engineering Center ATTN:SSCNC-YB
Natick, MA 01760-5020

10. SPONSORING / MONITORING AGENCY REPORT NUMBER
NATICK/TR-97/017

11. SUPPLEMENTARY NOTES
Point of Contact: Steven P. Paquette (508) 233-5430

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for Public Release;
Distribution Unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

Many Army Clothing and Individual Equipment (CIE) systems used today were designed to accommodate male soldiers in the 5th-95th percentile range for critical body dimensions. Thus, female soldiers whose body dimensions are outside the design envelope may be compromised. This study was conducted to determine the compatibility of some currently fielded systems with body dimensions of female soldiers. Participation was limited to female soldiers whose height did not exceed 5' 5", the 5th percentile value of male soldiers' height. Tasks associated with the operation of five workstations were evaluated by 205 subjects. The workstations included a mobile kitchen, a fuel tanker, a fork lift and two other vehicles. Static and functional fit characteristics of 11 CIE items were also evaluated on 203 subjects. The workstation testing revealed difficulties, particularly among shorter subjects, in executing tasks involving overhead reach and in positioning vehicle seats for unobstructed outside views. Fit characteristics of 8 of the 11 CIE items were found to be unacceptable on more than 15% of the subjects. The best-fitting CIE sizes tended to be too large and long, particularly on shorter subjects. Potential solutions to the compatibility problems were developed and cost estimates were generated for implementing the solutions.

14. SUBJECT TERMS

	ANTHROPOMETRIC CONSIDERATIONS	
COMPATIBILITY	FEMALES	FUEL TANKERS
ARMY SYSTEMS	BODY DIMENSIONS	MOBILE KITCHEN
ANTHROPOMETRY	WORKSTATIONS	JOB PERFORMANCE

15. NUMBER OF PAGES
221

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

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PREFACE

This study was funded by the Army Study Program, Office of the Deputy Under Secretary of the Army for Operations Research, in order to begin identifying the suitability of U.S. Army systems for the ever-increasing number of female users. The Directorate of Human Resources (DHR), Office of the Deputy Chief of Staff for Personnel (ODCSPER) served as the study sponsor, with Dr. Mike Fischl of DHR as program coordinator. Dr. Don Headley, Army Research Laboratory Human Research and Engineering Directorate Liaison to the ODCSPER, provided program coordination for the MANPRINT Directorate.

The work described in this report was performed by GEO-CENTERS, INC. under contract to the U.S. Army Natick Research, Development, and Engineering Center.

The data reported in this manuscript were collected by a team of GEO-CENTERS, INC. employees: Karen Burke, Janine Monarrez, and Phil Niro. Thanks are also due to Donna Gaeta for preparation of the final manuscript. This study could not have been completed without the excellent support of these individuals.

Special thanks are owed to eleven major subordinate command groups of Ft. Hood, TX, and the 1st COSCOM of Ft. Bragg, NC, for providing test subjects during a time of heavy training and preparation for deployment to Bosnia. Thanks are also due to the maintainers at ECS 65, Ft. Devens, MA, for training the data collection team on the use of several vehicular workstations.

Within the U.S. Army Natick Research, Development, and Engineering Center, we also thank Mr. Steve Nye and Mr. John Lupien of the Operational Forces Interface Group for their coordination of the U.S. Army posts and subjects who participated in this study.

EXECUTIVE SUMMARY

This study assessed the compatibility of 5 U.S. Army workstations and 11 U.S. Army clothing and individual equipment items, with the anthropometry of female soldiers 5'5" and shorter. Two hundred and five (205) soldiers from the 4th Infantry Division at Ft. Hood, TX, participated in the workstation evaluation; 203 soldiers from the 82nd Airborne Division at Ft. Bragg, NC, participated in the clothing/individual equipment evaluation.

PROBLEMATIC WORKSTATION VARIABLES AND SUGGESTED SOLUTIONS

Mobile Kitchen Trailer (MKT75)

Problems:

a) Installing utensil holder (too high for 58.0%)

b) Retrieving and replacing fire extinguisher (too high for 50.3%)

c) Opening and closing range cover (too high for 28.7%)

d) Unlocking range cover prop (out of reach for 29.3%)

Suggested Solutions:

a) Add extensions to holder

b) Move fire extinguisher to floor

c) Replace rear hinge prop with front vertical prop/handle

Heavy Expanded Mobility Tactical Truck Fuel Tanker (M978)

Problems:

a) Reaching fuel-flow valves (too high for 63.3%)

b) Closing rear hatch (too high for 17.4%)

Suggested Solutions:

a) Use ladder provided

b) Provide strap pull

Heavy Equipment Transporter (M1070)

Potential Problem:

a) Opening and closing hood (too high as tested for 63.1%)

Suggested Solution: To be determined

10K Rough Terrain Forklift (M10A)

Problems:

a) Sighting forkends (obstructed for 15.9%)

b) Sighting rearward (obstructed for 26.5%)

Suggested Solutions:

a) Evaluate newest model

b) Provide convex mirror

Light Tracked Command Post Carrier (M577A2)

Problem:

a) Sighting forward (obstructed for 15.1%)

Suggested Solution:

a) Reposition seat post

PROBLEMATIC CLOTHING/INDIVIDUAL EQUIPMENT ITEMS AND SUGGESTED SOLUTIONS

CW Trigger Finger Mitten (Unacceptable fit for 96.1%)

Problems:

a) Thumb and hand too long

b) Index finger flexion impaired

c) Making a fist impaired

Suggested Solution:

a) Development of smaller size(s)

CVC Coverall (unacceptable fit for 88.5%)

Problems:

a) Coverall back too wide and long

b) Crotch and pant length too long

Suggested Solution:

a) Development of integrated sizing system with adjustability

Mechanics' Coverall (unacceptable fit for 71.7%)

Problems:

a) Coverall torso too wide

b) Crotch and pant length too long

Suggested Solution:

a) Development of female-specific sizes

ALICE Frame with Pack (unacceptable fit for 61.5%)

PASGT Vest (unacceptable fit for 43.1%)

Enhanced Tactical Load Bearing Vest (unacceptable fit for 29.0%)

Problems:

a) Items incompatible with each other

b) Torso lengths too long

c) Bust disaccommodated

Suggested Solutions:

a) Development program to address female sizing and anatomical protection

b) Support ongoing Modular Body Armor/Load System Program to system engineer new components

ECWCS Parka (unacceptable fit for 26.5%)

Problems:

a) Parka waist length too long

b) Sleeves too long

c) Hood too large for unhelmeted head

Suggested Solutions:

a) Field modify snowskirt

b) Shorten sleeve pattern

Wet Weather Trousers (unacceptable fit for 15.5%)

Problems:

a) Abdomen and buttocks areas too loose

b) Crotch too long

c) Marching, climbing and squatting hindered

Suggested Solutions:

a) Fit-test improved rainsuit

b) Reduce frictional resistance of fabric

c) Issue suspenders

TOTAL ESTIMATED COST OF SUGGESTED RETROFITS: $4.5 mil

COMPATIBILITY OF ARMY SYSTEMS WITH ANTHROPOMETRIC CHARACTERISTICS OF FEMALE SOLDIERS

I. INTRODUCTION

Many U.S. Army systems currently in the field were designed some years ago when the primary users of the systems were male soldiers. The typical design standard was to accommodate the 5th through the 95th male percentile values for critical design dimensions. As the number of women in the U.S. Army increased, the disparity between male and female body dimensions and proportions became increasingly apparent. For example, the 5th percentile value for Stature (height) of male soldiers is 5'5" (165.1 cm). This value, which exceeds by 5" the 5th percentile value for stature of female soldiers, corresponds to the 65th percentile value for the females (Gordon et al., 1989). The disparity indicates that approximately 65% of the U.S. Army female population is likely to be outside the typical design envelope for U.S. Army systems designed using Stature as a critical dimension.

Given these anthropometric comparisons, concern was expressed by the Department of the U.S. Army as to whether women who must use U.S. Army systems will be able to perform their jobs without impediment. For example, will the female soldier be able to see out of vehicle cabs and over consoles? Will she be able to reach controls, such as foot pedals, handles, and triggers? Will she be adequately protected by protective clothing?

This study was conducted to determine the compatibility with female anthropometry of currently fielded, representative U.S. Army systems; specifically, workstations, protective clothing and individual equipment, and work-related equipment. Compatibility assessments focused on the relationships between the item and female height/reach characteristics. For those items that were found to disaccommodate females, possible solutions were developed and estimates of costs involved in implementing the solutions were generated.

II. METHODS

Survey Items

To identify candidate workstations to be included in detailed field studies, surveys regarding ease of use, functionality, and compatibility of a variety of workstations and work-related equipment were administered to active duty military personnel at Ft. Drum, NY, Ft. Devens, MA and Ft. Bragg, NC. In addition, literature reviews were conducted, and discussions were held with the Operational Forces Interface Group at the U.S. Army Soldier Systems Command, Natick Research, Development and Engineering Center (Natick, MA). As a result of these activities, vehicles to a greater extent than non-vehicle workstations were identified as potential sources of problems due to incompatibility with female anthropometry. In an attempt to include non-vehicle workstations, AR 611-201 (1986) was used to identify representative U.S. Army work areas. U.S. Army occupational fields were classed into eight functional areas: Artillery/Defense, Engineering/Construction, Communications/Electronics, Main-tenance/Transportation, Industrial Support, Supply/Food Service, Medical, and Administrative/Office. The surveys of military personnel had revealed only non-anthropometric problems in Medical and Administrative/Office fields, leaving six relevant areas. Representative classes of workstations were identified in each of these remaining functional areas. Specific workstations were then selected to represent each equipment class. Todd et al. (1995) list the workstations considered along with the reason for inclusion or exclusion of each from the study. Table 1 is a lists of the workstations included in the study.

Table 1. Workstations Studied

WORKSTATION ITEMS	
AREA	**ITEM**
Artillery/Defense	M577 Light Tracked Command Post Carrier
Engineering	M10A 10K Rough Terrain Fork Lift
Communications	M577 Light Tracked Command Post Carrier
Transportation	M1070 Heavy Equipment Transporter
Industrial Support	M978 Heavy Expanded Mobility Tactical Truck Fuel Tanker
Supply/Food Service	MKT75 Mobile Kitchen Trailer

To identify protective clothing and individual equipment (CIE) systems for evaluation, surveys regarding the fit of a wide array of standard issue clothing and individual equipment were administered to active duty U.S. Army personnel at Ft. Drum, Ft. Devens, and Ft. Bragg. In addition, Natick project officers for each protective area were interviewed, literature was reviewed, and a computer simulation of theoretical accommodation rates was performed. Based on these fact-finding activities, some CIE items were excluded from consideration for the following reasons: 1) theoretical disaccommodation rates were low; 2) a program already existed to address female fit problems; 3) soldiers and project officers concurred that the fit of the item was not a problem; 4) female specific sizes existed; or 5) the item was being discontinued. Todd et al. (1995) present a list of the clothing and individual equipment items considered and the reason for inclusion or exclusion from the study. The clothing and individual equipment items selected for the study represent both linear and circumferential fit issues for various segments of the body (excluding feet). These items are also representative of a broad range of protective clothing systems. The final list of the protective clothing and individual equipment items studied is presented in Table 2.

Experimental Variables

The evaluations of the workstations and of the CIE were conducted separately at two U.S. Army posts using active-duty female soldiers as subjects. The five workstations were evaluated at Ft. Hood, TX; the 11 CIE items were evaluated on a separate sample of female soldiers at Ft. Bragg, NC. Participation was limited to females whose Stature did not exceed 5'5", the 5th percentile value for Stature of male soldiers (Gordon et al., 1989). At both study sites, anthropometric measurements were taken on the participants and qualitative assessments of compatibility were made as the participants interfaced with the workstations or the CIE.

Table 2. Clothing and Individual Equipment Items Studied

CLOTHING/INDIVIDUAL EQUIPMENT		
AREA	**ITEM**	**MIL SPEC**
Hands	Light Duty Work Glove	CID-A-A-52055
	Cold Weather Trigger Finger Mittens	MIL-M-810
Head	Ballistic Helmet (PASGT)	MIL-H-44099
Lower Body	Wet Weather Trousers	MIL-P-43907
Upper Body	Extended Cold Weather Clothing System (ECWCS) Parka	MIL-P-44188
Whole Body	Combat Vehicle Crewman's Coverall	MIL-C-44077A
	Mechanics' Coverall	MIL-C-2202H
Torso	Enhanced Tactical Load Bearing Vest	MIL-V-44323
	ALICE Field Pack with External Frame	MIL-S-43834AE
	Ballistic Vest (PASGT)	MIL-B-44053A
	MC1-1 Parachute Harness	MIL-H-27893E

Workstations

The body dimensions measured in the workstation evaluation were principally length and reach variables that characterize the major linear segments of the body. The dimensions and their correlation with Stature are listed in Table 3. Descriptions of each measurement are found in Appendix A.

Table 3. Anthropometric Dimensions Measured in Workstation Evaluation and Correlation with Stature (Cheverud et al., 1990)

Anthropometric Variable	Correlation with Stature
Stature	N/A
Eye Height, Sitting	0.748
Functional Leg Length	0.847
Crotch Height	0.840
Hand Length	0.636
Overhead Fingertip Reach, Ext.	0.929
Popliteal Height	0.808
Thumbtip Reach	0.752
Weight	0.529

Subjects wore their own undergarments, nylon shorts, and a t-shirt while the body measurements were taken. To assess accommodation of a workstation, typical tasks associated with operation and maintenance of the workstation were identified and a four-point scale was established for evaluating the level of difficulty in performing each task. Each point on the scale was defined by

guidelines that included observations of the body postures assumed by the subject while performing the task and the subjects' opinions regarding task difficulty. Each task associated with a workstation was determined to be acceptable or unacceptable based upon the rating received on the difficulty scale.

Clothing/Individual Equipment

The anthropometric data acquired on subjects in the CIE evaluation were body size measurements used primarily for clothing issue. The dimensions and their correlation with Stature are presented in Table 4. Appendix A presents a description of each measurement. Subjects were measured while wearing their own undergarments, nylon shorts, and a t-shirt. Head Circumference, Head Breadth, and Head Length were taken with devices calibrated to indicate predicted PASGT helmet size, rather than anthropometric measurements of the head. Thus, subjects' head dimensions were not obtained.

Table 4. Anthropometric Dimensions Measured in CIE Evaluation and Correlation with Stature (Cheverud et al., 1990)

Anthropometric Variable	Correlation with Stature
Stature	N/A
Weight	0.529
Chest Circumference	0.222
Hand Length	0.636
Hand Circumference	0.464
Waist Circumference	0.188

The factors considered in assessing accommodation of the CIE were derived from military technical manuals, military specifications, interviews with clothing developers and users, and

clothing design principles. The assessments focused on evaluation of fit, with the subject assuming a static standing posture as well as performing simple movements, such as raising the arms, bending at the waist, and squatting. An item was declared to be an unacceptable fit on a subject if the item did not satisfy a predetermined number of fit factors being assessed. Judgments regarding each factor were made by the evaluators, based upon their observations and the subjects' opinions.

Experimental Design

This study was limited to collecting data on females 5'5" and shorter. Therefore, an experimental/control group design was not possible. Furthermore, random sampling was not possible because unit commanders selected the participants, who were usually enlisted personnel and tended to be the shortest females in the unit. Stature represents the independent variable; level of difficulty performing workstation tasks and acceptability of CIE fit represent dependent variables. This study employs an *ex post facto* case study design wherein the independent variable, Stature, is presumed to drive differences in accommodation and is not directly manipulated to test the hypothesis. No conclusions can be made about males of a similar Stature or about females above 5'5" in Stature.

Description of the Samples

The workstation evaluation included a sample of 205 female soldiers from the 4th Infantry Division, Ft. Hood, TX. All of the soldiers were 5'5" and shorter. Table 5 presents the race and age proportions of the sample for those subjects with complete data. Table 6 presents the summary statistics of the anthropometric data for all subjects.

Table 5. Race by Age Proportions of the Workstation Sample

	White	Black	Hispanic	Asian/ Pacific Islander	American Indian/ Alaskan Native	Mixed/ Other	TOTAL
Missing	0 (0.0%)	1 (0.5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.5%)
17-20 yrs	24 (11.9%)	12 (5.9%)	2 (1.0%)	0 (0.0%)	1 (0.5%)	1 (0.5%)	40 (19.8%)
21-24 yrs	31 (15.3%)	31 (15.3%)	9 (4.5%)	7 (3.5%)	1 (0.5%)	2 (1.0%)	81 (40.1%)
25-30 yrs	17 (8.4%)	20 (9.9%)	6 (3.0%)	2 (1.0%)	0 (0.0%)	2 (1.0%)	47 (23.3%)
30+ yrs	10 (5.0%)	16 (7.9%)	5 (2.5%)	1 (0.5%)	0 (0.0%)	1 (0.5%)	33 (16.3%)
TOTAL	82 (40.6%)	80 (39.6%)	22 (10.9%)	10 (5.0%)	2 (1.0%)	6 (3.0%)	202(100%)

Table 6. Anthropometric Characteristics of the Workstation Sample

Anthropometric Variable	Mean	S.D.	Minimum	Maximum	N
Stature (mm)	1575.47	48.16	1409	1651	205
Crotch Height (mm)	742.33	36.58	635	836	205
Eye Height, Sitting (mm)	725.11	27.49	658	797	204
Functional Leg Length (mm)	972.04	40.57	871	1090	203
Hand Length (mm)	176.10	7.90	153	207	204
Popliteal Height (mm)	356.54	18.33	298	398	204
Overhd Ftip Rch, Ext (mm)	2096.33	74.27	1847	2246	204
Thumbtip Reach (mm)	710.64	31.07	617	796	205
Weight (kg)	59.16	8.48	42.80	86.50	204

The clothing and individual equipment (CIE) items were evaluated on a separate sample of 203 female soldiers from the 82nd Airborne Division, Ft. Bragg, NC. Table 7 presents the race and age proportions of the sample for those subjects with complete data. Table 8 presents the summary statistics of the anthropometric measurements for all subjects.

Table 7. Race by Age Proportions of the Clothing/Individual Equipment Sample

	White	Black	Hispanic	Asian/ Pacific Islander	American Indian/ Alaskan Native	Mixed/ Other	TOTAL
Missing	0 (0.0%)	1 (0.5%)	0 (0.0%)	1 (0.5%)	0 (0.0%)	0 (0.0%)	2 (1.0%)
17-20 yrs	8 (3.9%)	11 (5.4%)	1 (0.5%)	2 (1.0%)	0 (0%)	2 (1.0%)	24 (11.8%)
21-24 yrs	30 (14.7%)	42 (20.6%)	9 (4.4%)	3 (1.5%)	2 (1.0%)	3 (1.5%)	89 (43.6%)
25-30 yrs	15 (7.4%)	27 (13.2%)	5 (2.5%)	2 (1.0%)	1 (0.5%)	2 (1.0%)	52 (25.5%)
30+ yrs	8 (3.9%)	21 (10.3%)	6 (2.9%)	1 (0.5%)	0 (0%)	1 (0.5%)	37 (18.1%)
TOTAL	61 (29.9%)	102 (50.0%)	21 (10.3%)	9 (4.4%)	3 (1.5%)	8 (3.9%)	204 (100%)

Table 8. Anthropometric Characteristics of the Clothing/Individual Equipment Sample

Anthropometric Variables	Mean	S.D.	Minimum	Maximum	N
Stature (mm)	1578.02	43.85	1440	1651	203
Chest Circumference (mm)	922.55	69.02	772	1114	203
Waist Circumference (mm)	745.73	69.73	591	975	203
Hand Length (mm)	173.22	8.29	155	198	156
Hand Circumference (mm)	186.96	8.48	162	208	152
Weight (kg)	60.42	8.37	44.50	87.20	203

*For some subjects hand measurments were inadvertently omitted

Treatment of the Data

Prior to analysis, the data were checked for accuracy and edited as required. Statistical tests were also carried out to determine whether the study samples were representative of the U.S. Army population of females 5'5" and shorter with regard to race, age, and body dimensions. The source of the data for the U.S. Army population was the 1988 Anthropometric Survey of U.S. Army Personnel (ANSUR) conducted by Gordon et al. (1989).

After computer entry, the raw data were cleaned in three steps. First, descriptive statistics were computed to identify outlier values of the variables. Outliers were corrected or deleted as necessary. Next, a case from each day's data collection was chosen at random, and every entry of the case was compared against the original data sheet for accuracy to establish the error rate. The error rate was found to be 4 errors per 2040 variables entered, low enough to feel confident that data entry mistakes were minimal. Last, trends for each variable were subjectively assessed for plausibility based on evaluators' impressions of the trends observed during data collection in the field. The fit and difficulty outcomes were found to agree with field experience.

The Race and Age proportions of the samples were not representative of those of the U.S. Army female population 5'5" in Stature and shorter according to the 1988 Anthropometric Survey of U.S. Army Personnel (Gordon et al., 1989). This is an important consideration because Race and Age can greatly influence body size and shape (Finch and Hayflick, 1977; Gill and Rhine, 1990). Weighting the proportions of Race and Age in the samples so that they are representative of the current U.S. Army population proportions can control gross differences in body size and shape related to racial/ethnic variability.

To determine whether weighting on Race or Age group was necessary, each study sample was analyzed to identify any differences in anthropometric values within the sample attributable to Race or to Age. Each sample was tested four ways: 1) unweighted, using six Race groups and four Age groups as in ANSUR; 2) unweighted, collapsing sparse ($n < 5$) Race or Age cells into the adjacent cell to detect differences that were missed above because of low power; 3) weighted, to detect differences due to Race/Age proportional interactions using the six Race groups and four Age groups; and 4) weighted, collapsing sparse, low power cells into adjacent cells. Differences between ANSUR and the study samples in Race and Age composition are presented below, along with findings from these analyses of the anthropometric values of the samples.

Weighting the Workstation Data for Representativeness

Compared to population proportions from ANSUR, the workstation data appeared to oversample Hispanics and Asian/Pacific Islanders, while undersampling Whites and Blacks. Younger soldiers (less than 25 years of age) were disproportionately oversampled, while those aged 25 years and older were underrepresented. Table 9 presents a comparison of the sample and population Race/Age proportions.

Table 9. Distribution of Race by Age Group (%) for Workstation Sample

% OF TOTAL	**WHITE**		**BLACK**		**HISPANIC**		**ASIAN/ PACIFIC ISLANDER**		**AMERICAN INDIAN/ ALASKAN NATIVE**		**MIXED/ OTHER**		**TOTAL**	
	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*
17-20 yrs	10.2	***11.9***	6.6	***5.9***	.7	***1.0***	.2	***0.0***	.1	***0.5***	.5	***0.5***	18.4	***19.8***
21-24 yrs	14.7	***15.3***	13.2	***15.3***	.9	***4.5***	.6	***3.5***	.1	***0.5***	.4	***1.0***	30.0	***40.1***
25-30 yrs	12.7	***8.4***	14.7	***9.9***	1.2	***3.0***	.7	***1.0***	.1	***0.0***	1.0	***1.0***	30.3	***23.3***
30+ yrs	11.3	***5.0***	8.0	***7.9***	.7	***2.5***	.6	***0.5***	.2	***0.0***	.4	***0.5***	21.3	***16.3***
TOTAL	49.0	***40.6***	42.6	***39.6***	3.4	***10.9***	2.1	***5.0***	.7	***1.0***	2.4	***3.0***	100	***100***

For all four testing schemes, ANOVA controlling for Race and Age was run between means of the anthropometric variables. The analyses yielded statistically significant differences (Bonferroni correction of $p \leq .05/9$ anthropometric variables $=.0055$) attributable to Race, but no significant findings attributable to Age (Appendix B). Because Race and not Age explained the anthropometric differences in the sample, it was necessary to weight the sample on Race only (Table 10).

Table 10. Calculation of Final Weights for Workstation Data

RACE CELL	SAMPLE n	SAMPLE %	ANSUR n	ANSUR%	DESIRED n	WEIGHT
White	82	40.60	665	49.0	98.918	**1.20631**
Black	80	39.60	578	42.5	85.976	**1.07471**
Hispanic	22	10.89	46	3.4	6.842	**0.31102**
Asian/Pacific Islander	10	4.95	28	2.1	4.165	**0.41649**
AmerInd/Alaskan/Mixed	8	3.96	41	3.0	6.099	**0.76233**
TOTAL	202	100.00	1358	100.0	202	

Data of the American Indian/Alaskan Native category (n=2) were combined with the Mixed/Other category because the sparseness of these cells has low power to detect statistical differences. Inspection of the descriptive statistics for each anthropometric variable showed that the means, minimums, and maximums of the American Indian/Alaskan Native group were contained within the larger Mixed/Other group.

The data of ANSUR females 5'5" and shorter were used to determine whether or not there were differences in measuring techniques between ANSUR and the present study. A comparison of the weighted means (Table 11) shows that the anthropometry of the two databases are very similar with the exception of mean Popliteal Height, which differs by 19.12 mm between the study and ANSUR samples. This difference is not explained by the error allowed due to differences in measuring precision (Gordon et al., 1989), nor is it a function of a lower tail outlier.

Table 11. Comparison of Weighted Workstation Sample Means and ANSUR Sample Means

DIMENSION	Sample Mean	ANSUR Mean	Difference Between Means	Allowable Error	Sample S.D.	ANSUR S.D.
Stature (mm)	1581.19	1591.25	-10.06	11.0	44.16	40.62
Crotch Height (mm)	746.23	749.03	-2.80	10.0	34.15	33.59
Eye Height Sitting (mm)	727.29	723.6	3.69	8.0	27.32	26.97
Functional Leg Lgth (mm)	975.96	987.2	-11.24	17.0	37.80	37.63
Hand Length (mm)	176.84	176.85	-0.01	3.0	7.44	8.46
Popliteal Height (mm)	358.85	377.97	-19.12	7.0	16.66	18.28
Overhd Ftip Rch Ext (mm)	2105.53	2100.73	4.80	20.0	67.97	67.30
Thumbtip Reach (mm)	712.99	718.23	-5.24	20.0	29.98	29.41
Weight (kg)	59.27	59.42	-0.15	0.3	8.40	7.13

Weighting the CIE Data for Representativeness

The CIE sample proportions differed from the ANSUR population proportions in that Blacks, Hispanics, and Asian/Pacific Islanders were generally oversampled, and Whites were undersampled (Table 12). In addition, soldiers aged 21-24 years were overrepresented in the study sample, and the remaining three age groups were undersampled.

Table 12. Distribution of Race by Age Group (%) for Clothing/Individual Equipment Sample

% OF TOTAL	WHITE		BLACK		HISPANIC		ASIAN/ PACIFIC ISLANDER		AMERICAN INDIAN/ ALASKAN NATIVE		MIXED/ OTHER		TOTAL	
	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*	ANSUR	*SAMPLE*
Missing	0.0	***0.0***	0.0	***0.5***	0.0	***0.0***	0.0	***0.5***	0.0	***0.0***	0.0	***0.0***	0.0	***1.0***
17-20 yrs	10.2	***3.9***	6.6	***5.4***	.7	***0.5***	.2	***1.0***	.1	***0.0***	.5	***1.0***	18.4	***11.8***
21-24 yrs	14.7	***14.7***	13.2	***20.6***	.9	***4.4***	.6	***1.5***	.1	***1.0***	.4	***1.5***	30.0	***43.6***
25-30 yrs	12.7	***7.4***	14.7	***13.2***	1.2	***2.5***	.7	***1.0***	.1	***0.5***	1.0	***1.0***	30.3	***25.5***
30+ yrs	11.3	***3.9***	8.0	***10.3***	.7	***2.9***	.6	***0.5***	.2	***0.0***	.4	***0.5***	21.3	***18.1***
TOTAL	49.0	***29.9***	42.6	***50.0***	3.4	***10.3***	2.1	***4.4***	.7	***1.5***	2.4	***3.9***	100	***100***

As described above, statistical tests were run in four different ways to detect any significant differences in anthropometry within the sample due to Race or to Age. ANOVA and/or Kruskal Wallis tests by Race and Age revealed statistically significant differences (Bonferroni correction of $p \leq .05/4$ variables=.0125) for Weight, Chest Circumference, and Waist Circumference that were attributable to Age. There were no significant differences attributable to Race (Appendix B).

Because Age was significantly associated with differences in Weight, Chest Circumference, and Waist Circumference, the sample was weighted on population Age proportions to control for gross differences between population and sample proportions (Table 13).

Table 13. Calculation of Final Weights for Clothing/Individual Equipment Data

AGE CELL	SAMPLE n	SAMPLE %	ANSUR n	ANSUR%	DESIRED n	WEIGHT
17-20 yrs	24	11.88119	250	18.40943	37.18704	1.54946
21-24 yrs	89	44.05941	407	29.97054	60.5405	0.68023
25-30 yrs	52	25.74257	412	30.33873	61.28424	1.178543
30+ yrs	37	18.31683	289	21.2813	42.98822	1.161844
TOTAL	202	100.0	1358	100.0	202	

The weighted means for sample Stature, Weight, Chest Circumference, and Waist Circumference were compared to those of ANSUR females 5'5" and shorter (Table 14). Absolute differences between means for these anthropometric measurements were found to exceed the allowable error (Gordon et al., 1989), indicating that, despite weighting, the anthropometry of the sample was different than that of the ANSUR group. On average, sample means for Weight, Chest Circumference, and Waist Circumference were larger than the ANSUR means.

Table 14. Comparison of Weighted Clothing/Individual Equipment Sample Means and ANSUR Sample Means

DIMENSION	Sample		ANSUR		Difference	Allowable Error
	Mean	(S.D.)	Mean	(S.D.)		
Weight (kg)	60.15	(8.57)	59.42	(7.13)	0.73	0.3
Stature (mm)	1576.32	(44.06)	1591.25	(40.62)	-14.93	11.0
Chest Circ (mm)	920.54	(68.53)	899.39	(60.16)	21.15	15.0
Waist Circ (mm)	744.57	(70.66)	718.92	(60.41)	25.65	11.0

Clearly, factors other than Age and Race influenced the anthropometry of the sample. That Stature of the sample is less, on average, than that of ANSUR may be explained as an artifact of sampling bias. Commands knew that only females 5'5" and shorter would be surveyed in this evaluation and so tended to send their shortest females, rather than a range of Statures. This is not the explanation, however, for the differences in body circumferences.

Because many test subjects were assigned to relatively sedentary occupations, they might have generally larger circumferences and higher body weights for their Statures than the overall Army population. Accordingly, the data were assessed to see what proportion of the sample exceeded the Army "Weight for Height" retention standards (AR 600-9, 1986). Results showed that 50% of the unweighted sample exceeded the standards, by an average of 6.12 kg (13.5 pounds). In contrast, 38% of the ANSUR female population 5'5" and shorter exceeded the standards, by an average of 4.90 kg (10.8 pounds). That a larger proportion of subjects in the sample exceeded the standards by a larger average weight than the ANSUR population probably explains the larger circumferences of the study sample. The ANSUR database is currently used to design, size, and generate tariffs for many CIE items, and thus the items are sized to accommodate these individuals. Therefore, it is not reasonable to assume that the responses of "overweight" females in the sample are invalid. But because the sample is, on average, comprised of larger females than are actually in the U.S. Army population as represented by ANSUR, the data were tested to determine if the acceptability of fit was different for those who exceeded the Weight for Height standards and those who did not. The data of the workstation sample were also examined for conformance with the standards.

Although each sample's Race or Age proportions were weighted to match population proportions, as reflected by the ANSUR data, Race or Age-based comparisons about accommodation cannot be made. Weighting only controls for gross differences in body size due to population Race/Age proportions, and the samples of each Race and Age group are not random nor representative of the U.S. Army population.

III. WORKSTATION EVALUATION RESULTS

Five workstations representing six occupational fields were evaluated for compatibility with the height and reach characteristics of female soldiers 5'5" and shorter in stature. Typical work tasks for each workstation were identified and evaluated on a four-point scale for level of difficulty to accomplish the task. Data collection sheets with a listing of all tasks evaluated are presented in Appendix C. Level of difficulty was determined by the evaluator, using biomechanical cues and input from the subject. "Inability to Accomplish" a task was often self-defining, and this was also indicated if subjects contacted surfaces that would be unsafe to touch under normal conditions (e.g., moving parts, hot surfaces, steam zones, non-load bearing surfaces, etc.). In general, "Extreme Difficulty" was indicated by an unacceptable posture involving full extension of one or both legs (tips of toes) or arms (fingertips), hyperextension or hyperflexion of the back or neck, extreme body angles (very small or very large), and large or asymmetric moments about the joints. Other factors included facial expressions, exclamations, ballistic motions (e.g., jumping, yanking, jerking, etc.) and uncontrolled movement of workstation parts not due to surface slipperiness or temperature. "Moderate Difficulty" was indicated by an acceptable posture that may have involved full extension of no more than one body segment, less extreme body angles, and no contact with untouchable surfaces to accomplish the task. A level of "No Difficulty" was indicated by postures that appeared to minimize the moments about joints, distribute loads symmetrically about joints, minimize risk of contact with untouchable surfaces, and minimize extreme body angles and extreme extension or flexion. Upon request, subjects repeated performances, discussed their reasons for adopting a particular body posture to accomplish the task, and stated what level of difficulty they experienced to help the evaluator determine the level of difficulty rating.

For purposes of analysis of the task data, the difficulty ratings for a task were collapsed into two categories, "Acceptable" and "Unacceptable". Ratings of "Moderate Difficulty" and of "No Difficulty" were placed in the acceptable category; ratings of "Extreme Difficulty" and of "Inability to Accomplish" the task were placed in the "Unacceptable" category. A decision rule was applied

to determine whether, based upon the number of subjects in the unacceptable category, the task was likely to be a problem for the Army female population. The approach used to develop the rule is presented in Appendix D. According to this rule, if 15% or more of the subjects fell in the unacceptable category for a given task, the task was declared likely to be a problem for the Army female population. The following presentation is organized by workstation. Only the problematic tasks are discussed here. Appendix E contains data on the difficulty levels of all tasks. The anthropometric and demographic variables associated with the problematic tasks are also described and summarized here. Recommendations for modifications are discussed at the end of each section.

Statistical Tests

The Fisher Exact Test (α=.05) was applied to the weighted data to determine whether acceptable and unacceptable task performances were related to the subjects' "Weight for Height" standard status (i.e., met/exceeded Army standards). On all tasks, acceptability and unacceptability of subjects' performance were found to be independent of "Weight for Height" status (Appendix F).

Analyses were also carried out to assess whether acceptable and unacceptable task execution were related to the subjects' body sizes. The F-test for homogeneity of variance was done to determine if the variances of each body dimension were equal for subjects in the acceptable and in the unacceptable categories. If variances were equal, ANOVA was used to compare the two groups of subjects on each body dimension; the Mann Whitney U test was applied if variances were not equal. The significance level of $p < .05$ was adjusted using the Bonferroni Correction to account for the increased likelihood that differences would be obtained as an artifact of the number of body dimensions tested. Thus, because there are nine body dimensions, a corrected significance level of $p < .0055$ (.05/9 variables =.0055) indicated that subjects in the acceptable and the unacceptable categories differed significantly on a body dimension. The complete results of the analyses of body dimensions are presented in Appendix F. Significant findings are discussed below. Proposed solutions and associated developmental and hardware costs are also discussed. Costs are rough estimates only and do not include costs related to implementation in supply system fielding and maintenance.

Missing data

It was decided to omit some data from analysis because: a) they were found to have been collected in an invalid way, or b) they exhibited more variation than was practical to explain. An example of the former was related to the utensil holder in the Mobile Kitchen Trailer. Early in testing, it was discovered that the utensil holder, which was being evaluated over the range, is rarely located there in practice in order to avoid burn injuries. The holder was thereafter evaluated over the cooking racks, and the data collected over the range were defined as missing. Some seat distances and heights described as "full up" exhibited high levels of variation, indicating high intra- or inter-measurer error. Because this error could confound analysis, these data were omitted. Some data are missing because equipment arrived late or because equipment was broken temporarily. Other data are missing because of weather-related difficulties or because of lack of daylight.

Mobile Kitchen Trailer (MKT75)

The Mobile Kitchen Trailer (MKT) is an expandable, self-contained, trailer-mounted, field food service system. It includes preparation counters, cooking areas, and a serving line (TM-10-7360-206-13, 1984). The version of the Mobile Kitchen Trailer tested here was not the latest model. The differences in design were not, however, related to the work tasks chosen for the study. Twelve operational tasks were surveyed for the MKT. Problematic tasks are summarized in Table 15 and discussed below.

Table 15. Problematic Tasks--Mobile Kitchen Trailer MKT75

Task	Acceptable	Unacceptable	Missing	TOTAL
Install Utensil Holder	20.4%	58.0%	21.6%	100%
Replace Fire Extinguisher	47.1%	50.3%	2.6%	100%
Remove Fire Extinguisher	54.4%	43.5%	2.2%	100%
Release Range Cover Prop	68.6%	29.3%	2.2%	100%
Lower Range Cover	69.2%	28.7%	2.2%	100%
Raise Range Cover	78.2%	19.6%	2.2%	100%

Installing the Utensil Holder

The original study protocol called for the utensil holder to be located across the inside corners of the roof assembly frame (221 cm or 87" from the floor) over the range as depicted in the technical manual. This location was changed, however, when subjects consistently reported that, in practice, the utensil holder was usually not located over the range because the steam from the range heats the utensils to an injurious temperature. Instead, subjects reported, the utensil holder is usually installed over the cooking rack. Therefore, utensil holder data collected on subjects for whom the rack was located over the range (n=40) were excluded from analysis. Of the remaining 161 subjects, 119 subjects (58.0%) exhibited extreme difficulty or an inability to install the utensil holder on the roof frame. Subjects' postures were characterized by standing on the tips of toes, straining with fully extended arms and fingertips, and hyperextension of the back and neck (see Figure 1).

Anthropometric Viariables

Subjects who had moderate or no difficulty installing the utensil holder and those who had extreme difficulty or could not do the task differed significantly (p <.0055) on all anthropometric dimensions except weight. This is not surprising since most of the variables are components of Stature or are highly correlated with Stature (Table 3). Table 16 presents a comparison of the anthropometric variables grouped by difficulty level. Of particular interest is the dimension Overhead Fingertip Reach, Extended, which most closely resembles the posture assumed by subjects when reaching up to install the holder. The average Overhead Fingertip Reach, Extended of subjects who had extreme difficulty reaching the holder is 208.6 cm, approximately 12 cm (5") *less* than the distance from the roof frame to the ground over the cooking racks (221 cm).

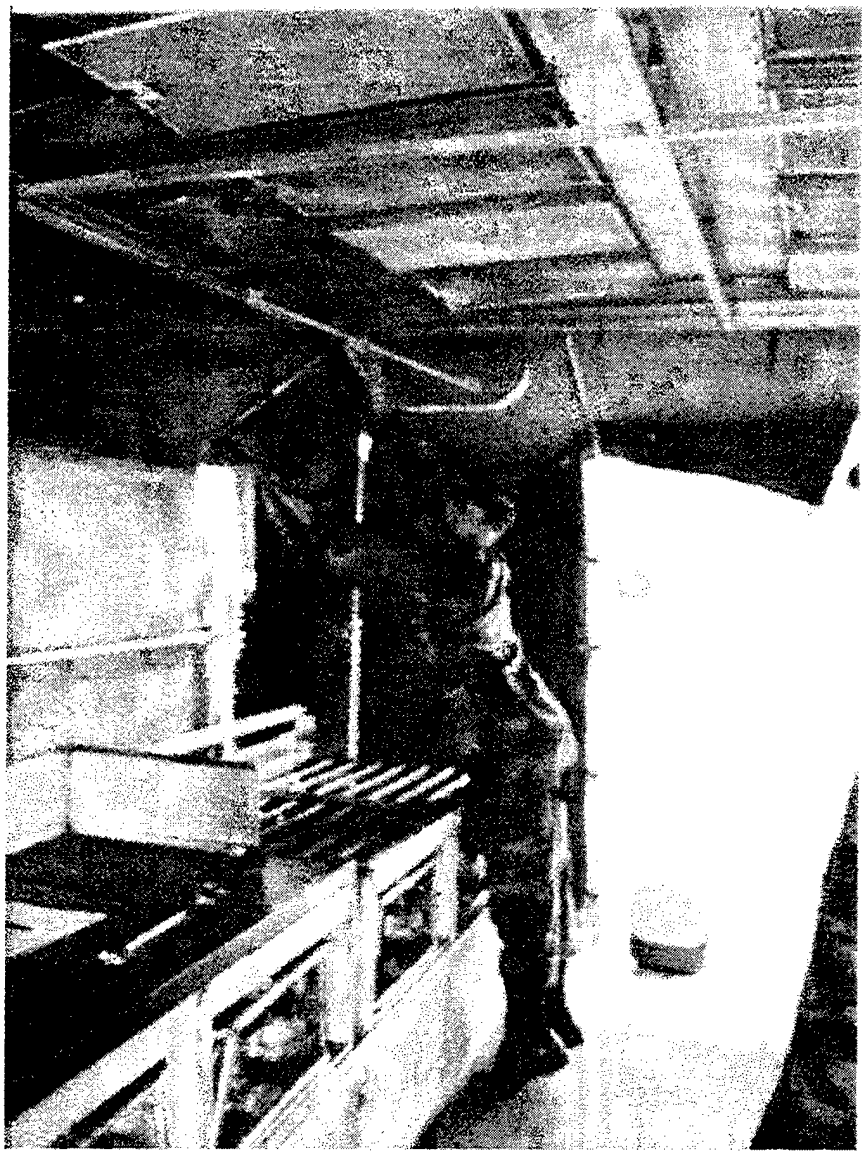

Figure 1
MKT-75 Mobile Kitchen Trailer: Install Utensil Holder

Table 16. Significantly Different Anthropometric Variables by Level of Difficulty in Installing MKT75 Utensil Holder (Weighted Totals)

Variable (all units in millimeters unless otherwise indicated)	Acceptable Difficulty (n=41.9)		Unacceptable Difficulty (n=118.9)		Difference Between Means
	Mean	Std. Dev.	Mean	Std. Dev.	
Stature	1615.75	26.51	1567.77	40.44	47.98
Eye Height, Sitting	740.48	26.30	720.21	25.92	20.27
Functional Leg Length	999.06	30.98	966.83	35.20	32.87
Crotch Height	763.76	33.89	738.89	30.91	24.47
Hand Length	181.31	7.82	176.01	6.92	5.03
Overhead Fingertip Reach, Ext.	2158.33	49.01	2086.29	63.60	72.04
Popliteal Height	370.31	12.89	354.61	15.74	15.70
Thumbtip Reach	728.96	30.18	707.09	29.01	21.87

Proposed Solution: Add Vertical Extensions to Holder Ends

Many subjects found that they could not install the utensil holder on the roof frame or could not do it without extreme difficulty because the roof frame was too high. Some subjects reported that, in practice, they used the drawers provided in the kitchen instead of the holder to store utensils because the drawers are far easier to reach. Natick project officers for the MKT point out that use of the drawers may be convenient but it is not sanitary. Instead, they suggested redesigning the utensil holder so that it is U-shaped with vertical extensions at each end that will allow the roof frame to be reached from a lower height. The difference in means for Overhead Fingertip Reach, Extended (the dimension that most closely resembles the posture to install the holder) is about 3" (7.2 cm) for those who could install it without too much difficulty and those who could not. The distance between the height of the roof frame and the average Overhead Fingertip Reach, Extended for the study sample is about 4" (10 cm). Thus, the length of the holder arms should be at least 4". The estimated cost of the new holder would include labor costs for development and the cost of the materials.

Removing and Replacing the Fire Extinguisher

Like the utensil holder, the 16-lb fire extinguisher is mounted on the roof assembly frame. Extreme difficulty or an inability to remove the fire extinguisher from its hanging hook was experienced by 43.5% of the subjects. Typical body postures involved fully extended legs on toes, fully extended arms, and hyperextended necks and backs. Subjects who managed to reach the fire extinguisher could usually only grasp the bottom; its weight would then cause it to topple out of control once it was pushed off the hook. Some subjects were able to retain enough grip to enable a semi-controlled descent. However, it was not the weight of the extinguisher that was problematic, but its high location. The extinguisher's weight at the end of a long-moment arm resulted in a large torque about the shoulder joint that overcame the upper body strength of most subjects. Replacing the extinguisher was even more difficult (50.3% had extreme difficulty or could not do it) because the extinguisher had to be lifted and controlled farther, not only to the hook but past it to engage the hanging ring. Most subjects could grasp it only from the bottom, and the subsequent torque caused the subject to lose control of the fire extinguisher (Figure 2).

Anthropometric Viariables

Those subjects who had moderate or no difficulty installing the fire extinguisher and those who had extreme difficulty or could not do the task differed significantly (p <.0055) on all anthropometric dimensions except Weight (Table 17). Again, this is expected as the variables are components of Stature or are highly correlated with Stature. For those who had problems, the average Overhead Fingertip Reach, Extended (207 cm) was 21 cm (8") less than that required to reach the handle of the fire extinguisher.

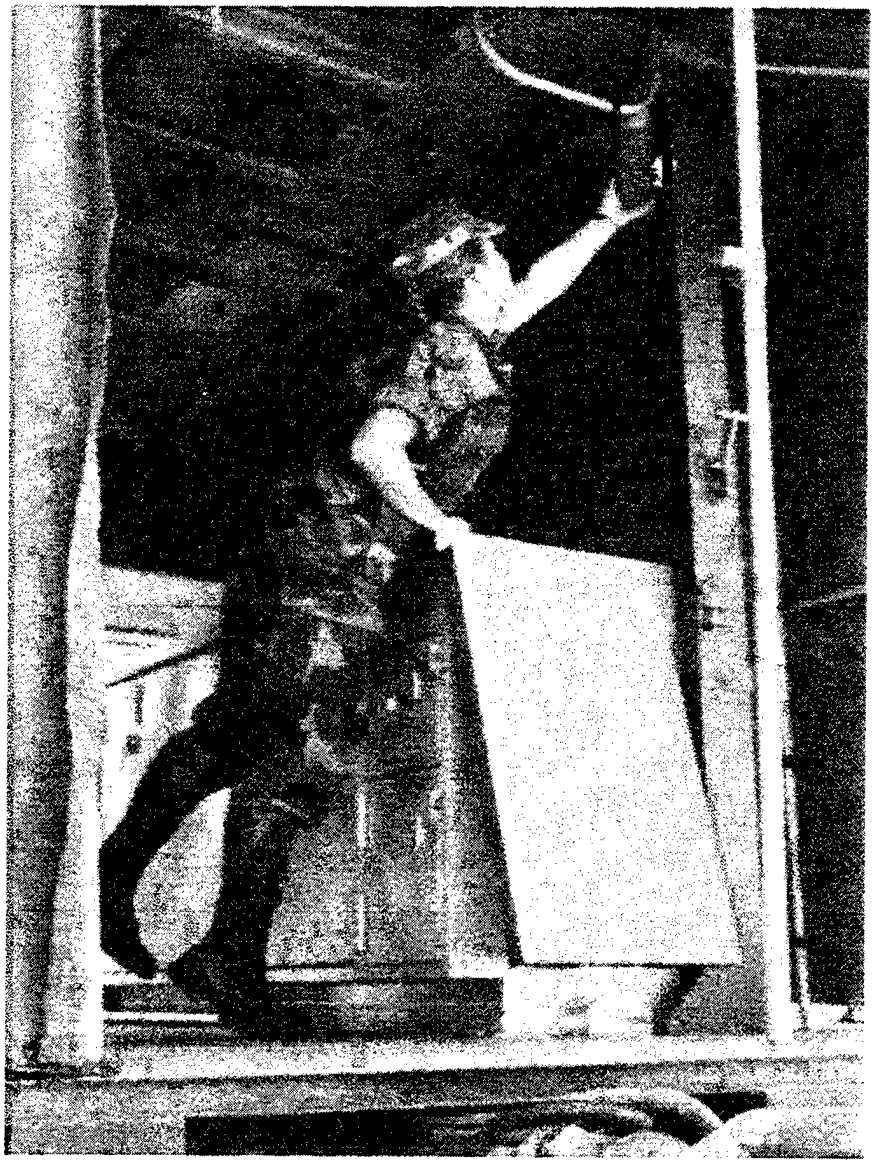

Figure 2
MKT-75 Mobile Kitchen Trailer: Replace Fire Extinguisher

Table 17. Significantly Different Anthropometric Variables by Level of Difficulty in Replacing MKT75 Fire Extinguisher (Weighted Totals)

Variable (all units in millimeters unless otherwise indicated)	Acceptable Difficulty (n=96.6)		Unacceptable Difficulty (n=103.0)		Difference Between Means
	Mean	Std. Dev.	Mean	Std. Dev.	
Stature	1604.65	30.68	1559.97	44.11	44.68
Eye Height, Sitting	735.58	26.60	720.07	25.87	15.51
Functional Leg length	991.30	29.49	962.30	39.71	29.00
Crotch Height	763.56	24.58	729.93	34.59	33.63
Hand Length	179.46	6.90	174.29	7.02	5.17
Overhead Fingertip Reach, Ext.	2144.30	46.89	2069.87	65.67	74.43
Popliteal Height	367.05	12.17	351.16	16.82	15.89
Thumbtip Reach	725.55	24.61	701.81	30.52	23.74

Proposed Solution: Provide New Location on Floor

Many subjects reported that they had never hung the fire extinguisher from the roof hook, but instead placed it on the floor. When asked about its propensity to fall or be kicked over, they replied that it was better than not being able to reach it. Natick project officers for the MKT75 agreed that relocation was a sensible solution, and installation of a hook under the drop-leaf counter would keep the fire extinguisher from being kicked over. A sticker mounted just above it on the corner post could indicate the new inconspicuous location.

An untested but similar size item located on the roof frame next to the fire extinguisher is the kerosene lantern. Weighing slightly less than the fire extinguisher, this item posed similar difficulties to remove and replace in pilot tests, but was not surveyed since the heavier fire extinguisher represented the worse case scenario. Unlike the fire extinguisher, access to the lantern could not be improved by storing it on the floor. Natick project officers have explored upgrading existing MKTs by replacing the kerosene lantern with battery powered lighting in the short term, and generator powered lighting for the long term. Costs associated with both approaches have been developed.

Operating the Range Cover

Subjects were asked to use the handle to raise the range cover from its closed position to its freestanding position, then to release the sliding hinge located at the right rear, and to use the handle or top edge to return the cover to its original closed position. Body contact with the range was not allowed, as in actual use the range would be very hot. The subject was asked to maintain control of the cover so it did not inadvertently contact the soldiers who, in practice, would be standing behind it. About 20 % of the subjects were unable to raise, or had extreme difficulty in raising the cover because they could not maintain their grasp on the cover without contacting the range. More subjects (29.3%) had extreme difficulty reaching the prop to release the cover and then lowering the range cover (28.7%). Even if they avoided contact with the range, many subjects appeared to be draped over the top of the range in the steam zone (Figure 3).

Anthropometric Viariables

Levels of difficulty in raising the cover were related to statistically significant differences ($p < .0055$) between means for all anthropometric variables except Weight. Difficulties releasing the range cover prop were related to significant differences in all variables except Weight and Eye Height, Sitting. Subjects who had moderate or no difficulty lowering the cover differed from those who had extreme difficulty or could not do the task on the anthropometric measurements presented in Table 18.

Figure 3
MKT75 Mobile Kitchen Trailer: Lower Range Cover

Table 18. Significantly Different Anthropometric Variables by Level of Difficulty in Lowering MKT75 Range Cover (Weighted Totals)

Variable (all units in millimeters unless otherwise indicated)	Acceptable Difficulty (n=141.8)		Unacceptable Difficulty (n=58.8)		Difference Between Means
	Mean	Std. Dev.	Mean	Std. Dev.	
Stature	1591.52	37.77	1556.97	49.04	34.55
Functional Leg length	984.59	34.85	955.73	37.53	28.86
Crotch Height	753.60	32.16	728.05	33.22	25.55
Hand Length	178.27	7.41	173.10	6.02	5.17
Overhd. Fingertip Reach, Ext.	2122.74	58.69	2063.70	72.00	59.04
Popliteal Height	362.70	15.72	349.16	15.18	13.54
Thumbtip Reach	720.94	27.31	694.33	28.68	26.61

Proposed Solution: Replace Rear Prop With Front Prop/Handle

Many soldiers were unable to open and close the cover without risk of burn injury. A prop bar located in the front would provide soldiers a means to open and close the cover without using the handle on the top and make the prop easier to reach. Replacing the current slotted prop with one similar to the kind used to prop hoods in automobiles will obviate the need to reach over the steam zone or lean against the range to reach the top of the cover or the hinge. It may also reduce the degradation of the current slotted prop. Many soldiers do not remember to unlock the prop before trying to close the cover (perhaps because of its inconspicuous location at the rear of the assembly), and as a result, the prop becomes damaged over time and does not support the cover reliably. A frontally located prop bar would be structurally stronger and may also provide a visual cue to remind soldiers to unprop the cover first, reducing damage to both cover and hinges. Testing development will be necessary to determine a nonconductive material, an appropriate front location. Limited testing will be necessary to assure that the new design allows the range pans to be inserted and removed without impedance and without inadvertently displacing the prop.

Costs of Proposed Solutions

Table 19 lists estimated costs of implementing changes to the MKT discussed above.

Table 19. Mobile Kitchen Trailer--Suggested Retrofits and Estimated Costs

Retrofit Item	Unit Cost	Qty.	Number of MKTs in Use	Estimated Retrofit Cost
Twin Fluorescent Lights†	$37.99	6	4426	$1 mil
Battery Pack†	$500	1	4426	$2.2 mil
Fire Extinguisher Hook	use existing			-0-
Range Cover Prop	$12.26	2	4426	$109k
U-Shaped Utensil Holder	$8.00	1	4426	$35.4k
Total MKT Retrofit Cost				**$3.3 mil**

†Costs taken from Auer&Sutherland, 1996 (no labor costs available)

M978 Heavy Expanded Mobility Tactical Truck Fuel Tanker

The Heavy Expanded Mobility Tactical Truck (HEMTT) M978 is a 5-ton fuel tanker with a dual hose system located at the rear for dispensing fuel. Fifteen work tasks were evaluated on the most recent model. Three of the 15 were found to pose unacceptable levels of difficulty for more than 15% of the sample (Table 20). Some subjects were unable to evaluate the HEMTT because it was not available until two days after testing began. Hose crank data were collected temporarily on the left hose because the right hose crank became jammed. Additionally, some data were not collected because, in the early morning, soldiers could not see well enough to execute certain tasks and, on some days, dewfall and rainfall made surfaces too slippery to handle safely.

Table 20. Problematic Tasks--M978 HEMTT Fuel Tanker

Task	Acceptable	Unacceptable	Missing	TOTAL
Reach V7 Fuel Flow Valve	5.6%	63.3%	31.1%	100%
Reach V8 Fuel Flow Valve	23.7%	45.2%	31.1%	100%
Reach and Close Rear Hatch	77.8%	17.4%	4.8%	100%

Operating Fuel Flow Valves

The most difficult tasks to perform were operating the fuel flow valves. Each hose had its own fuel flow valve labeled V7 (left hose) and V8 (right hose). The design of the fuel dispensing section was not symmetrical in that, although the valve handles were the same shape, V7 was located higher and further to the rear than was V8. Of 141 subjects, 63.3% were unable to reach V7 at all, or only with extreme difficulty; 45.2% had similar trouble reaching valve V8. Subjects often had to stand on toes, fully extending one arm while holding onto the truck frame for balance with the other arm (see Figure 4).

Anthropometric Viariables

Those subjects who could and could not reach V7 differed significantly (p <.0055) on all anthropometric variables except Eye Height, Sitting and Weight; subjects who could and could not reach V8 differed significantly (p <.0055) on all variables except Weight. Table 21 presents the differences in means of significant anthropometric variables for those subjects who could and could not acceptably reach V7, as it was the worse of the two tasks.

Figure 4
M978 HEMTT Fuel Tanker: Reach Fuel Flow Valve V7

Table 21. Significantly Different Anthropometric Variables by Level of Difficulty in Reaching V7 (Weighted Totals)

Variable (all units in millimeters unless otherwise indicated)	Acceptable Difficulty (n=11.4)		Unacceptable Difficulty (n=129.8)		Difference between Means
	Mean	Std.Dev	Mean	Std. Dev.	
Stature	1629.43	11.81	1576.30	42.20	53.13
Functional Leg Length	1006.63	25.72	973.77	35.28	32.86
Crotch Height	781.16	24.31	743.65	31.90	37.51
Hand Length	184.11	9.38	176.89	7.18	7.22
Overhd. Fingertip Reach, Ext.	2187.85	18.79	2099.71	65.76	88.14
Popliteal Height	374.53	11.98	357.77	15.99	16.76
Thumbtip Reach	740.33	31.15	711.18	30.34	29.15

Proposed Solution: Use HEMTT Ladder to Reach Fuel Flow Valves

Many subjects were unable to reach the fuel flow valves without extreme difficulty. Oshkosh Truck Corporation, the vehicle manufacturer (telephone communication, Calliari, March 1996), recommended that shorter soldiers use the ladder provided on the vehicle when practical. Modifying valve handle shape or length may have a domino effect on the design or configuration of adjacent hardware; using the ladder appears to be a practical and safe solution with minimal financial impact.

Closing and Locking the Rear Hatch

The rear hatches (one for each left and right halves) enclosing the fuel dispensing assembly were top-hinged panels with gas-spring assists. When unlocked, the gas springs of the hatch applied upward force to rotate the hatch unassisted to its fully open, vertical position. To close the hatch, the soldier had to grasp the top leading edge firmly and overcome the force of the gas spring by exerting force continuously during the hatch's descent until the latch clicked into place. Approximately 17% of the soldiers experienced an unacceptable level of difficulty closing the hatch. These soldiers stood on toes with arms fully extended, a posture biomechanically disadvantaged for exerting downward force on the hatch (Figure 5).

Figure 5
M978 HEMTT Fuel Tanker: Close Rear Hatch

Because soldiers were on their toes, their hold on the hatch was precarious, and their risk of injury greater than if they were standing with their feet flat on the ground.

Anthropometric Viariables

Those subjects who could and could not close the hatch were significantly different (p <.0055) on all anthropometric variables. Table 22 presents the differences in means of the variables for those who closed the hatch with acceptable levels of difficulty and those who did not. The Overhead Fingertip Reach, Extended dimension closely approximates the posture soldiers would assume to close the hatch. The average Overhead Fingertip Reach for subjects who could not reach the hatch was 200.8 cm, which is 2.67 cm (1") higher than the open hatch height (198.1 cm) allowing about 1" of gripping surface.

Table 22. Significantly Different Anthropometric Variables by Level of Difficulty in Closing the HEMTT M978 Rear Hatch (Weighted Totals)

Variable (all units in millimeters unless otherwise specified)	Acceptable Difficulty (n=159.4)		Unacceptable Difficulty (n=35.8)		Difference Between Means
	Mean	Std. Dev.	Mean	Std. Dev.	
Stature	1596.10	31.84	1520.47	33.83	75.63
Eye Height, Sitting	731.63	25.57	708.07	26.00	23.56
Functional Leg length	987.85	29.69	927.64	28.59	60.21
Crotch Height	757.03	26.90	702.44	24.64	54.59
Hand Length	178.44	6.79	169.76	5.93	8.68
Overhd Fingertip Reach, Ext.	2128.89	47.85	2007.94	50.63	120.95
Popliteal Height	363.75	13.15	339.07	14.71	24.68
Thumbtip Reach	721.23	24.96	675.94	22.70	45.29
Weight (kg)	60.54	8.44	53.82	5.73	6.72

Proposed Solutions: Provide Strap to Pull Hatch Down

The top of the rear hatches were extremely difficult to reach for many females. Lowering the open height of the hatch by repositioning the gas springs is not recommended because the lower height may then impede the ability of taller soldiers to perform their tasks. Oshkosh recommended that a strap be installed at the front of the hatch so that the hatch is closed by pulling from underneath rather than pushing from the top. Because the difference between mean Overhead Fingertip Reach, Extended for those who could reach the hatch without extreme difficulty and those who could not, is about 5" (12.1 cm), it is recommended that the strap length be a loop between 6-8" (15.2-20.3 cm) long to allow for this difference in reach and for gripping area. Testing should determine the exact location, but it is recommended that the strap be located far enough away from the closing edge that it would not hang outside the hatch when closed. A flat weave nylon webbing is recommended as the strap fabric because: a) it is already approved for use in the Aviation Refueling System-HEMTT Tanker to strap hose assemblies in coils; b) it is a very commonly stocked webbing; and c) it is durable. A tubular nylon webbing was considered for its soft hand and high strength but rejected because it interfaces poorly with grommets and is not as commonly stocked as the flat weave webbing. Temperature and fire-resistant aramid webbings are available, but are probably unnecessary because: a) the temperature of proximal surfaces does not approach those necessary to degrade nylon 6,6 (489°F), and b) in the event of a fire, nylon does not support combustion (although the flammability of the strap would be a comparatively negligible concern in that event).

Costs of Proposed Solutions

Table 23 summarizes the retrofits and costs to implement a strap on the rear hatch to facilitate closing and locking.

Table 23. M978 HEMMT Fuel Tanker--Suggested Retrofits and Estimated Costs

Retrofit Item	Unit Cost	Number of HEMTTs in Use	Estimated Retrofit Cost
Hatch Strap: 2 (1"x18") Webbing, Textile Textured Nylon (MIL-W-43668)	$0.80	4700	$3,760
2 Grommets, Brass Spur Type, Size #1	$0.30	4700	$1,410
2 Nut and Bolt	$0.60	4700	$2,820
1 Hour Labor	$25/hr	4700	$117,500
Total M978 Retrofit Costs			**$125,490**

M1070 Heavy Equipment Transporter

The M1070 Heavy Equipment Transporter (HET) is a 20-ton truck with a trailer platform for winching, hauling, and carrying heavy equipment such as tracked vehicles and other trucks. The model evaluated in the field was different from the one upon which the original protocol was prepared (C-HET M911). Data are missing due to delays in delivery of a new vehicle and in developing a new protocol. Some tasks, it was found subsequently, were not executed according to the manufacturer's technical manual. These will be discussed below. Table 24 presents the data for the one task found to be problematic.

Table 24. Problematic Task--M1070 Heavy Equipment Transporter

Task	Acceptable	Unacceptable	Missing	TOTAL
Close Hood	24.5%	63.1%	12.5%	100%

Closing the Hood

The hood of the HET is a heavy shaped box, hinged at the front of the vehicle near the front bumper. It is supported by two interior, folding props, much like the kind that support fold-out

tables. The hood box rotates backwards from the driver's cab until the prop arm is fully extended. A spring assist mechanism (inoperative on the model evaluated) prevents the hood from opening too far and from slamming closed.

Because informal testing and consideration of the mechanics required indicated that the heavy rectangular hood was most easily operated from the front side of the hood, the data were collected by using the side handles to open and close the hood. It was subsequently found that the hood is opened from the front by using handholds built into the grill of the hood. Using the side handles, 14.7% of the subjects experienced unacceptable levels of difficulty in raising the hood to its fully open position. These subjects tended to be able to reach the handle in its fully down position but found it increasingly hard to maintain their grip and to exert upward force as the handle rotated up with the hood. Before the handle had reached its highest point, subjects had fully extended arms, fully extended legs on toes, hyperextended backs and necks, and therefore were biomechanically disadvantaged to control the hood's torque.

In order to close the hood, subjects first broke the tension of the straightened prop so that the hinge was pushed over center, and then grasped the side handle on the rotated hood box to pull it backwards. Subjects were asked to maintain control of the hood until it came to rest in the closed position. Under these stipulations, 63.1% of subjects were unable to close the hood or experienced extreme difficulty doing so. The height of the handle was again the cause of a large torque. Many subjects were fully extended (arms, legs, back, and neck) to reach the handle, and a few even stood on the tire rim or jumped to try to reach the handle. Once they had grasped the handle, many subjects tried to throw their body weight backwards to overcome the hood's inertia (see Figure 6). A few subjects even found this maneuver ineffective, as they were frankly hanging from the handle. Many lost control of the hood's movement as its own weight slammed it shut.

Figure 6
M1070 Heavy Equipment Transporter: Close Hood

Anthropometric Viariables

Statistically significant differences for all anthropometric variables except Eye Height-Sitting, Weight, and Hand Length were found between those subjects who experienced acceptable difficulty and displayed extreme difficulty or an inability to close the hood. Table 25 presents the means of the significantly different variables. The Overhead Fingertip Reach, Extended dimension closely approximates the posture soldiers would assume to close the hood; the mean for soldiers who experienced unacceptable difficulty was 209.2 cm, compared to 213.90 cm (a difference of nearly two inches) of those who could close the hood.

Table 25. Significantly Different Anthropometric Variables by Level of Difficulty in Closing the HET M1070 Hood (Weighted Totals)

Variable (all units in millimeters unless otherwise specified)	Acceptable Difficulty (n=50.2)		Unacceptable Difficulty (n=129.3)		Difference Between Means
	Mean	Std. Dev.	Mean	Std. Dev.	
Stature	1599.98	36.55	1574.10	42.14	25.88
Functional Leg Length	989.33	30.92	969.37	35.89	19.96
Crotch Height	761.31	31.07	739.53	31.64	21.80
Overhd Fingertip Reach, Ext.	2138.90	56.41	2092.46	65.03	46.44
Popliteal Height	365.04	15.50	356.21	15.76	8.83
Thumbtip Reach	724.83	28.22	708.49	29.95	16.34

Proposed Solution: To Be Determined

Unaware that the manufacturer recommends using the front grill handholds for opening and closing the hood (Van Sistine, 1996), evaluators assumed that the side handles located on the lower edge of the hood box nearest the driver's cab were designed to open the hood.

Because the hood was not opened or closed according to the manufacturer's manual instructions, no conclusive statement can be made as to whether opening and closing the hood was problematic for test subjects. However, the difficulty of the task can be assessed theoretically. Consideration of the mechanics required to overcome the hood's torque indicates that the side front would be the most effective point against which to apply an opening force because it appears to be the point farthest from the pivot point, and the handle allows use of large leg muscle groups. In contrast, the handholds located on the front of the M1070 appear to be located closer to the pivot point. Consequently, a person 5'5" or shorter would be applying force at an acute angle with primarily the upper body; the force that could be applied to overcome the hood's inertia would be small. The side handle is also located rather high, about 70" (177.8 cm) from the ground, but the pushing angle allows use of the leg muscles. For both approaches, however, when the hood rotates backwards, only the strength of the arms can be used until the hood rotates out of reach, and then no force at all can be exerted. Testing would have to determine whether this would happen before or after the hood was beyond its balance point when gravity would take over. The advantage of using the side handle would be lost when closing the hood, however, since an asymmetric pull would be required from above the head. Applying a pushing force to the front of the hood would then be more biomechanically effective.

Because this task was not executed according to the instructions in the manufacturer's technical manual, no recommendations are made for retrofit at this time. However, pilot testing on other trucks and mechanical theory suggest a front-opening hood is likely to be problematic for females 5'5" and shorter. Therefore, the HET and other heavy trucks (M939, M913) should be investigated to compare side-opening capability with front-opening capability.

M10A 10K Rough Terrain Forklift

The M10A forklift stands approximately eleven feet tall, can operate over rough terrain, and lift 10,000 pounds with its boom-type forks (TM-10-3930-643-10, 1990). The driver's cab is

mounted high due to the height of the tires and fork carriage. Ten operational or maintenance tasks were evaluated. Table 26 presents the problematic tasks. Some data are missing due to adverse environmental conditions and to insufficient daylight.

Table 26. Problematic Tasks--M10A Forklift

Task	Acceptable	Unacceptable	Missing	TOTAL
Sight Fork Ends	82.4%	15.9%	1.7%	100%
Sight 15ft Rearwards	70.8%	26.5%	2.7%	100%

Sighting Object at Fork Ends

Sighting the end of the fork is essential to inserting the fork into a loading palette slot. The forklift's large fork carriage can sometimes act to obstruct the view from the operator's compartment (Figure 7). This appeared to be the case for 15.9% of the subjects, who were asked to sight the fork ends marked with a flat, circular white object. These subjects had a tendency to push up and backwards to see the object, indicating that their body position was too far forward and not high enough. Body position was probably a function of seat position, and of subject anthropometry. However, the seat was positioned by the subject so as to be able to reach pedals, controls, and enable good general visibility.

Anthropometric Viariables

Subjects in the acceptable and in the unacceptable difficulty groups differed significantly on two of the anthropometric variables: Stature and Functional Leg Length (Table 27).

Table 27. Significantly Different Anthropometric Variables by Level of Difficulty in Sighting Objects at Fork Ends

Variable (all units in millimeters unless otherwise indicated)	Acceptable Difficulty (n=169.0)		Unacceptable Difficulty (n=32.5)		Difference between Means
	Mean	Std. Dev.	Mean	Std. Dev.	
Stature	1587.00	43.44	1538.25	42.69	48.75
Functional Leg Length	981.25	37.25	964.06	36.63	17.19

Solution: Already Addressed by Manufacturer

Sighting the fork ends and objects to the rear of the forklift were problematic for many subjects in the study (Figure 7). Conversation with the manufacturer, Komatsu-Dresser (personal communication, R. Major, April 1996) revealed that the task can also be a problem for individuals taller than 5'5". The obstruction to frontal visibility is the centrally located mast assembly (the large cylinder that controls the movement of the forks). Komatsu has replaced it with a double-masted assembly (the "High Visibility Mast"), which a Komatsu engineer says alleviates the problem considerably. In the event vision is still obstructed for shorter soldiers, the existing side shifter assembly, which shifts the fork carriage laterally, can be used to shift the carriage into a visually clearer area.

Sighting Object 15 Feet Right Rear

The forklift's large tires, high engine compartment, and counterweight can act to visually obstruct the view rearward of the operator's compartment (Figure 7). For 26.5% of the subjects, sighting a directional cone positioned 15 feet rear of the right tire was extremely difficult, or the cone could not be seen at all. Many subjects had to partially stand and/or twist right to see it, removing their feet from the pedals.

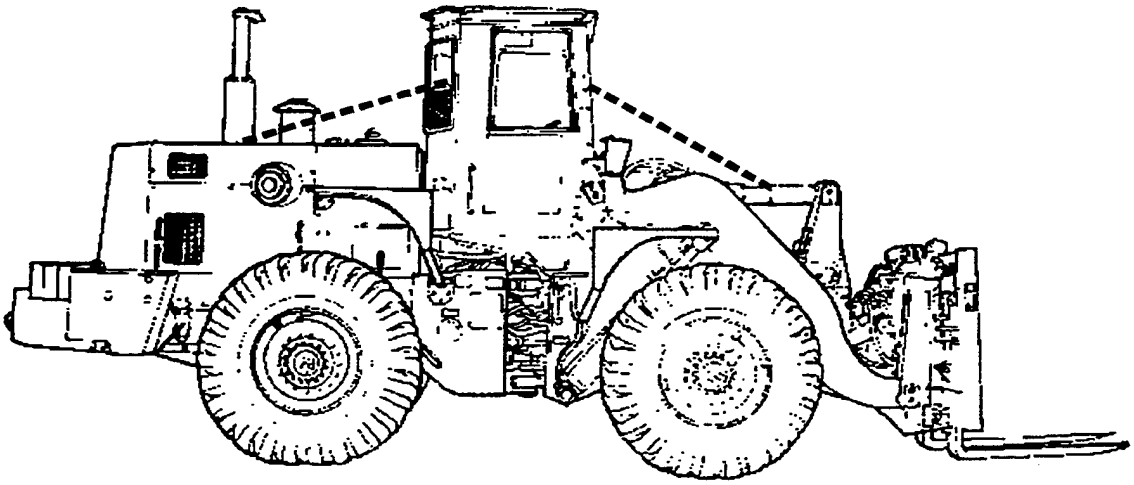

Figure 7
M10A Rough Terrain Forklift: Visibility Obstructed Forward and Rearward

Anthropometric Viariables

The anthropometric measurements of subjects who experienced an acceptable level of difficulty on this task did not differ significantly from the measurements of subjects who experienced unacceptable difficulty.

Proposed Solution: Provide Convex Mirror

Rearward visibility was obstructed by the length and bulk of the engine compartment that also acts as a counterweight to the fork carriage. Its length was determined as the wheelbase necessary to prevent the top-heavy vehicle from rolling over. Materials handling manuals direct that a second soldier serve as a ground guard for backing maneuvers; if the driver no longer sees the ground guard, he/she is to brake immediately. However, this instruction does not prevent the ground guard from being knocked down or run over, but rather is a response after the event. As a preferred alternative, a convex mirror (similar to those installed on commercial forklifts, tractors, buses, etc.) installed at the driver's right and angled down from the handrail should enable rearward visibility without changing seat posture. Adjustment of the mirror will require the operator to leave the seat, however. A swinging mount that allows the mirror to be pushed out of the way is recommended.

Cost of Proposed Solutions

Table 28 summarizes the costs of suggested retrofits to improve rearward visibility.

Table 28. M10A Rough Terrain Forklift--Suggested Retrofits and Estimated Costs

Retrofit Item	Unit Cost	Qty.	Number of M10As in Use	Estimated Retrofit Cost
12" Convex Mirror	30.01	1	1540	$46,215.40
Swing Mount	27.00	1	1540	$41,580.00
1 Hour Labor	$25/hr	1	1540	$38,500.00
Total M10A Retrofit Cost				**$126,295.40**

M577A2 Light Tracked Command Post Carrier

The M577A2 Command Post is an armored, tracked vehicle housing a command post and staff office equipped with mapboards, table tops, and communication equipment (TM-9-2350-261-10, 1990). The operation in the driver's compartment was evaluated. Twelve operational tasks were evaluated; one was deemed problematic (Table 29). Two tasks dealing with opening and closing the driver's hatch were omitted from analysis because the hatch's spring assist was broken, and the uncontrolled weight of the armored hatch was considered to pose a safety risk to both the evaluators and the subjects.

Table 29. Problematic Task--M577A2 Command Post Carrier

Task	Acceptable	Unacceptable	Missing	TOTAL
Vision Out of Driver's Hatch	77.0%	15.1%	7.9%	100%

Vision Out of the Hatch

With the seat adjusted upward so that vision out of the hatch, and operation of foot controls was enabled, subjects were asked to look at flat white objects nine inches in diameter (representing mines or other road obstructions) placed on the ground 25, 50, and 75 feet forward of the vehicle. The subject's posture was evaluated for whether or not a subject could sight these objects without hyperextending the neck, and for the visual intersection of the driver's hatch with the subject's line of sight. Approximately 15% of the subjects were either unable to see the objects, were eye level with the hatch, or had to hyperextend their neck (Figure 8).

Anthropometric Viariables

Subjects whose posture was acceptable and those whose posture was not differed significantly ($p < .0055$) in Stature, Eye Height Sitting, Hand Length, Overhead Fingertip Reach Extended, and Popliteal Height. Table 30 presents the significantly different anthropometric variables.

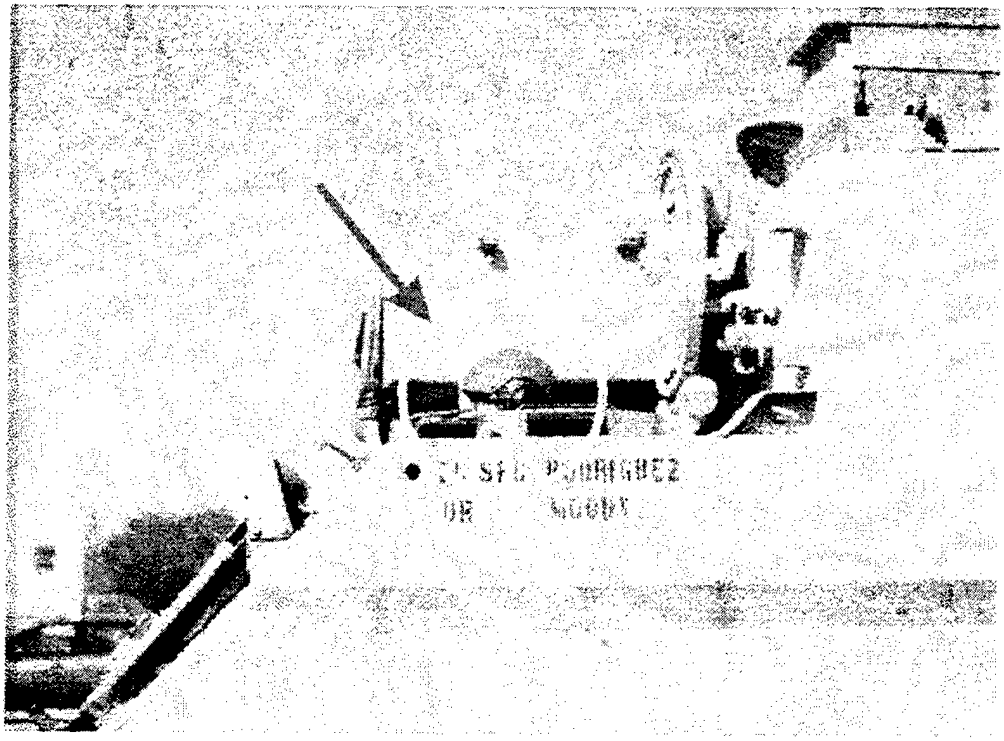

Figure 8.
M57728 Light Tracked Command Post Carrier: Vision Out of Hatch

Table 30. Significantly Different Anthropometric Variables by Level of Difficulty for Vision Out of N577A2 Hatch (Weighted Totals)

Variable (all units in millimeters unless otherwise specified)	Acceptable Difficulty (n=157.8)		Unacceptable Difficulty (n=31.0)		Difference Between Means
	Mean	Std. Dev.	Mean	Std. Dev.	
Stature	1590.99	37.62	1540.48	51.09	50.51
Eye Height, Sitting	732.61	25.66	706.22	25.16	26.39
Hand Length	177.62	7.39	172.87	6.66	4.75
Overhead Fingertip Reach, Ext.	2118.44	58.71	2055.41	81.14	63.03
Popliteal Height	361.17	15.04	349.74	20.26	11.43

Proposed Solution: Reposition Seat Post

With the seat adjusted up, some females were unable to sight objects out of the driver's hatch without hyperextending the neck or without the hatch obstructing their line of sight. The seat was adjusted high to see out of the driver's hatch and also to reach pedals and apparently does not adjust as high as needed. A seat cushion is not recommended because, although inexpensive, items like these tend to become separated from the vehicle. A more lasting solution may be to install the seat post higher. The difference in Eye Height, Sitting means between those who could see satisfactorily and those who could not was 2.6 cm or about 1". Rebolting the seat adjustment post to a higher position is feasible because testing showed that the lowest two adjustment notches were never used. These provide about two inches of vertical adjustability and could enable visibility without hyperextension of the neck or visual intersection with the hatch. The newer A3 model uses the same seat post but incorporates a fold-out pedal, which is located at the same height as the upper accelerator. It can be assumed that, because the dimensional locations are the same, females would experience the same difficulty in sighting as was found with the vehicle tested in the present study. The accelerator and brake pedals of the A3 model may need to be remounted slightly higher to accommodate the longer leg reach from the higher seat position; anthropometric fit testing should determine this.

Cost of Proposed Solutions

Developmental and fit testing to determine the repositioned location of existing parts and field labor would be needed to implement these recommendations (Table 31).

Table 31. M577A2-A3 Command Post Carrier--Suggested Retrofits and Estimated Costs

Reposition Seat Post	**Cost**	**Qty.**	**Number of M577s in Use (A1, A2, A3)**	**Estimated Retrofit Cost**
Developmental Testing	$20K	N/A	N/A	$20,000
Retrofit Labor	$25.00	1	5297	$132,425
Total M577A2-A3 Retrofit Cost				**$152,425**

IV. CLOTHING AND INDIVIDUAL EQUIPMENT EVALUATION RESULTS

The best-fitting sizes of 11 clothing and individual equipment (CIE) items were evaluated on 203 female soldiers 5'5" and shorter. The items were assessed in both static and functional modes. Static fit variables related to fit when the subject was in an upright, motionless posture; functional fit variables related to fit while the subject was performing a movement. Donning and doffing of the items were not assessed because subjects were assisted by evaluators to decrease evaluation time. Fit problems were identified using wrinkle analysis (lines of strain and sag), military fit guidelines (e.g., TM 10-227, 1994), and the guidance of Natick project officers. The particular fit variables considered in the assessment of each item are presented in the data collection sheets (Appendix C).

Algorithms specific to each item of CIE were established and applied to determine whether or not a subject had an acceptable fit in that item. A decision rule was also applied to determine whether, based upon the number of subjects with an unacceptable fit, the item was likely to be a fit problem for the Army female population. The approach used to develop the rule is presented in Appendix D. According to this rule, if 15% or more of the subjects had an unacceptable fit in a given item, the item was declared likely to be a problem for the Army female population.

Eight of the eleven CIE items assessed in this study were found to be unacceptable on 15% or more of the sample, and so these items were considered problematic. Table 32 presents each clothing item in descending order of unacceptable fit, that is, the "worst" items are presented first. Appendix G contains the frequencies of acceptability and unacceptability for all fit characteristics evaluated on each item.

Table 32. Summary Findings of Fit Acceptability of CIE Items (Weighted Data)

ITEM	ACCEPTABLE		UNACCEPTABLE		TOTAL
	n	%	n	%	n
CW Trigger Finger Mitten	7.8	3.9	193.8	96.1	201.6
CVC Coverall	23.3	11.5	178.3	88.5	201.6
Mechanics' Coverall	57.0	28.3	144.6	71.7	201.6
ALICE Lg. Pack w/ Ext. Frame	77.5	38.5	124.0	61.5	201.6
PASGT Vest	114.6	56.9	87.00	43.1	201.6
Tactical Load Bearing Vest	143.1	71.0	58.5	29.0	201.6
ECWCS Parka	148.1	73.5	53.5	26.5	201.6
Wet Weather Trouser	170.3	84.5	31.3	15.5	201.6
Light Duty Work Glove	180.7	89.6	20.9	10.4	201.6
PASGT Helmet	188.2	93.4	13.4	6.6	201.6
Parachute Harness	187.7	93.1	0.7	0.3	201.6

The eight CIE items that were found to be problematic in terms of fit on the study sample are discussed here. The discussion includes: 1) a description of the item; 2) the algorithms applied to determine the acceptability of fit of the item; 3) the static and functional fit characteristics that were found to be unacceptable; and 4) comparison of anthropometric data of subjects who had an acceptable fit with data of those subjects whose fit was unacceptable.

Statistical Tests

The Fisher Exact Test (α=.05) was applied to the weighted data in order to determine whether fit acceptability and unacceptability were related to subjects' "Weight for Height" standard status (i.e., met/exceeded Army standards). For all items except the PASGT vest, acceptability and unaccept-ability of subjects' fit were found to be independent of "Weight for Height" status (Appendix H).

Analyses were also carried out to assess whether fit acceptability and unacceptability were related to subjects' body sizes. The F-test for homogeneity of variance was done to determine if the variances of each body dimension were equal for subjects having an acceptable fit and those who did not. If variances were equal, ANOVA was used to compare the two groups of subjects on each body dimension; the Mann Whitney *U* test was applied if variances were not equal. The significance level of $p < .05$ was adjusted using the Bonferroni Correction to account for the increased likelihood that differences would be obtained as an artifact of the number of body-size variables tested. Thus, because there are four body-size variables, a corrected significance level of ($p < .05/4$ variables $p < .0125$) indicated that subjects with an acceptable fit and those not acceptably fit differed significantly on a body dimension. The complete results of the analyses of body dimensions are presented in Appendix H. Significant findings are discussed below.

Cold Weather Trigger Finger Mittens

The gauntlet mittens combine the third, fourth, and fifth fingers into one compartment, with separate compartments for the thumb and index finger (Figure 9). The mittens were evaluated over wool knit liners of a similar configuration. The mittens are made of an insulated, wind-resistant, water-repellent, cotton/nylon blend with a deerskin leather palm. The mittens are available in two sizes: Medium and Large.

Algorithm for Acceptability

Five static fit variables and three functional fit variables were used to evaluate the Cold Weather Trigger Finger Mitten. The mitten was determined to be acceptable if no more than two static fit variables or two functional fit variables were found to be problematic. Using this algorithm, the mitten was found to be unacceptable for 96.1% of the subjects, qualifying it as a problem according to the 15% rule (Appendix D).

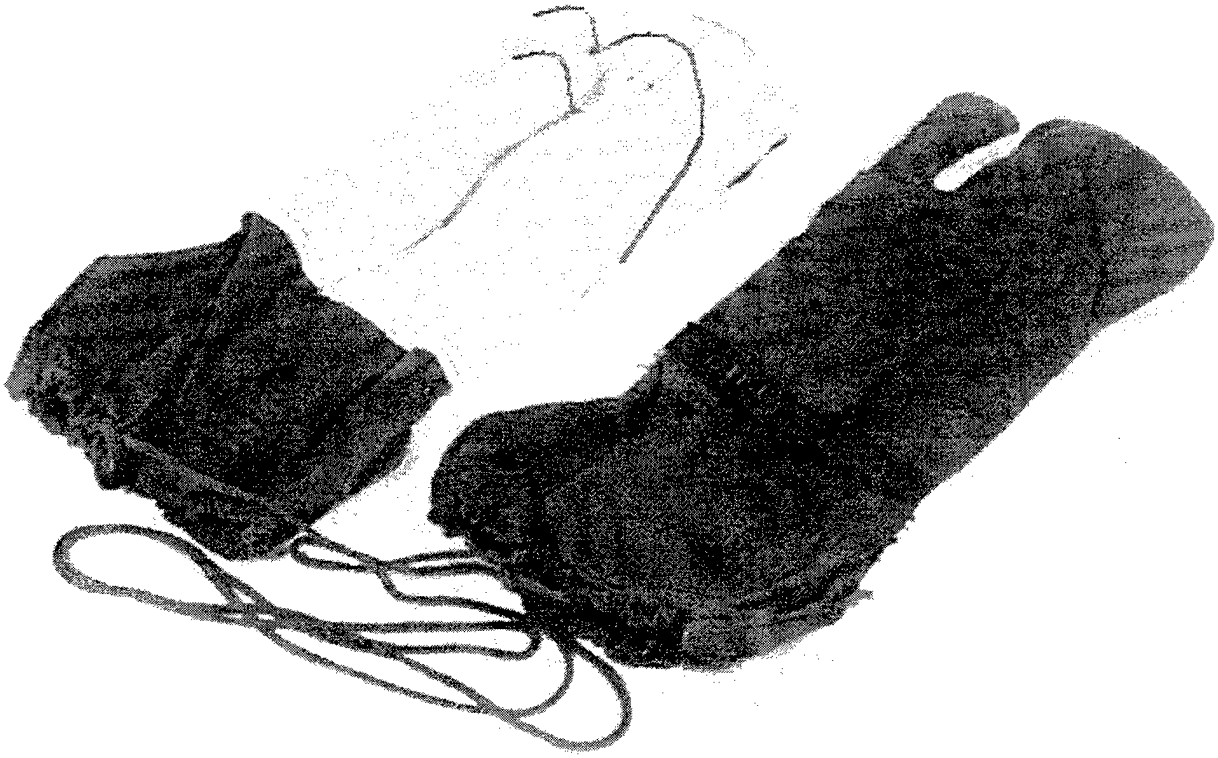

Figure 9
CW Trigger Finger Mitten
Drawn Lines Indicate Approximate Position of Subjects' Hands

Problematic Variables

In general, the mitten was found to be too large and long for most wearers. Problematic variables are presented in Table 33.

Table 33. Problematic CW Trigger Finger Mitten Fit Variables

Fit Variable	Overall Fit	
	Acceptable (n=7.8)	Unacceptable (n=193.8)
Overall Fit	**3.9%**	**96.1%**
Mitten Thumb Length Extends >3/8"		
No	67.4%	0.0%
Yes (too long)	32.6%	99.4%
Missing	0.0%	0.6%
Mitten Hand Extends >5/8"		
No	100%	1.0%
Yes (too long)	0.0%	98.4%
Missing	0.0%	0.6%
Flex Index Finger Into Trigger Shape		
Not Hindered	49.9%	2.6%
Hindered	41.3%	97.4%
Missing	8.7%	0.0%
Make Fist		
Not Hindered	84.9%	2.3%
Hindered	15.1%	96.2%
Missing	0%	1.6%

Regardless of whether the fit of the mitten as a whole was found acceptable or unacceptable, the length of the thumb was found to be excessively long (> 3/8") on almost all subjects. The mitten length was also typically too long (> 5/8") for those subjects with an unacceptable fit.

Functional fit variables that were problems for those who were unacceptably fit were making a fist and flexing the index finger into a "trigger" shape. Excessive length of the mitten hand may explain some of the difficulty in making a fist in that the excess fabric would bunch at the palm and

fingertips. It is possible that the thickness of the fabric layers was also a factor. Since the mitten is specifically designed to allow firing a weapon, the inability to make a fist or flex the index finger may seriously impede the ability to safely grasp the weapon or pull the trigger and negatively affect target acquisition.

Anthropometric Variables

Analyses were performed to contrast the Stature, Weight, Hand Circumference, and Hand Length measurements of subjects having an acceptable fit with subjects who did not. Only the difference between Stature means was statistically significant (p <.0125). Those who received an acceptable fit were, on average, 41.2 mm (1.6") taller than those who did not. That a statistically significant difference was found between Stature means is not surprising when one considers that Hand Length is highly correlated with Stature (r =.6355; Cheverud et al., 1990). Failure to obtain a statistically significant difference between Hand Length means is attributable to the fact that Hand Length was missing for six of the eight subjects who were accommodated, and the resulting power to detect differences was severely diminished. Table 34 presents the means and standard deviations for Stature.

Table 34. Significantly Different Anthropometric Variables by Fit of the Cold Weather Trigger Finger Mitten

VARIABLE	ACCEPTABLE FIT (n=7.8)		UNACCEPTABLE FIT (n=193.8)	
	Mean	Std. Dev.	Mean	Std. Dev.
Stature (mm)	1615.93	39.49	1574.73	43.57

Proposed Solution: Provide Smaller Size(s)

The CW Trigger Finger Mitten's thumb length and hand length were found to disaccommodate many females and prevented them from flexing the index finger and making a fist. Because no females predicted into the Large size, and because the thumb and hand length of the Medium size were too long for most females, it is logical to conclude that smaller size(s) of the mitten may address the fit problems observed. To introduce new sizes, the following steps are required:

1. Determine the number of sizes, the sizing dimensions, and the pattern dimensions
2. Examine the feasibility of manufacturing smaller size(s) using current mitten fabrics and construction techniques
3. Conduct anthropometric fit testing of a prototype on all females and smaller males
4. Wear test new sizes

The estimated cost for developing new mitten sizes is $50K

Combat Vehicle Crewman's Coverall

The coverall is a one-piece garment with a front-entry zipper; drop seat; elasticized waist, wrist, and ankle cuffs; and an extraction strap sewn to the armholes and upper back. It is worn in both summer and winter, and is sized to be worn over either undergarments or cold weather liners. As the name "Crew*man*" implies, this article of protective clothing was designed and sized specifically for use by men because related combat MOSs are currently restricted to men. The coveralls are available in 15 sizes.

Algorithm for Acceptability

The CVC coverall was evaluated over a t-shirt and undergarments without liners because pilot testing showed that the hip area tended to be tight on females. The best-fitting coverall size was evaluated on 14 static fit variables and seven functional fit variables. If no more than five static fit variables or no more than three functional fit variables were problematic, the overall fit of the CVC coverall was considered acceptable. Using this algorithm, 88.5% of the women who tested the garment were disaccommodated, and thus the item is considered a problem for the population.

Problematic Variables

In general, the coverall tended to fit the upper body too loosely and to be too long above and below the waist (Figure 10). Problematic variables are presented in Table 35.

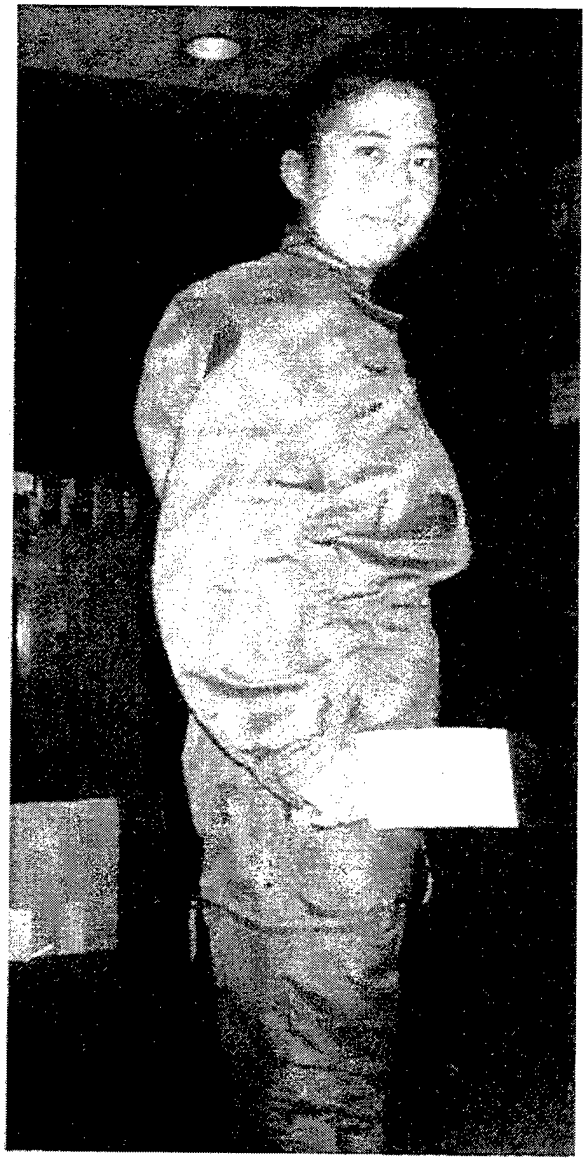

Figure 10
CVC Coverall

Table 35. Problematic CVC Coverall Fit Variables

Fit Variable	Overall Fit	
	Acceptable (n=23.3)	Unacceptable (n=178.3)
Overall Fit	**11.5%**	**88.5%**
Back Fit		
Satisfactory	24.2%	8.3%
Tight	0%	2.0%
Loose	75.8%	89.3%
Missing	0%	0.4%
Thigh Pocket Location		
Could Reach Bottom	21.7%	7.0%
Couldn't Reach Bottom	78.3%	92.3%
Missing	0.0%	0.7%
Knee Pleat Location		
At Knee	67.0%	55.6%
Below Knee	28.0%	40.4%
Missing	5.1%	4.0%
Crotch Location		
Satisfactory	51.1%	11.1%
More Than 2" Excess	48.9%	87.4%
Less Than 1" Excess	0.0%	0.9%
Missing	0.0%	0.7%
Waistband Location		
Satisfactory	67.4%	60.6%
Above Waist 1"	0.0.%	0.7%
Below Waist 1"	32.6%	38.8%
Marching in Place		
Not Hindered	97.1%	28.5%
Hindered	2.9%	71.1%
Missing	0.0%	0.4%
Climbing		
Not Hindered	97.1%	43.7%
Hindered	2.9%	54.6%
Missing	0.0%	1.7%
Reach Up		
Not Hindered	97.1%	41.6%
Hindered	2.9%	58.4%
Reach Side		
Not Hindered	100.0%	46.9%
Hindered	0.0%	52.2%
Missing	0.0%	0.9%

The predicted size was, in general, too long and loose for most subjects, and the next size down was too tight in the hip area. Most subjects (63.5%) felt that a looser fitting garment, even excessively so, presented a more military appearance than a tight-fitting one, and so chose to retain the looser initial try-on size as their best-fitting size. Independent of appearance, a loose-fitting garment can provide more burn injury protection than a tight one because the air boundary can act to slow heat transfer, but a loose garment can also get caught on obstructions or pulled into moving parts.

Many static fit variables were problems regardless of whether a subject was accommodated or disaccommodated and regardless of garment size. Despite overall acceptability, the back of the garment was excessively loose. This looseness is due to both the excessive width and length of the garment back and may compromise the effectiveness of the rescue harness sewn into the back of the coverall; it may also become a snag hazard around protruding objects. Concomitantly, the waistband location had a tendency to be too low regardless of whether the garment as a whole fit acceptably or not. The location of the thigh pocket was inconveniently low for those disaccom-modated; subjects had to lean sideways or forwards to reach the bottom of the pocket. The knee pleats, the function of which is to facilitate knee flexion, were also located below the knee on a number of subjects who had unacceptable fits. The crotch was excessively long (>2" from the subject's crotch) for both those who were overall acceptably fit and those who were not. Besides the discomfort due to chafing of the crotch seams along the inner leg and the lack of military appearance, an excessively deep crotch will likely hobble many leg movements. Note that the buttock and abdominal areas were not found to be loose, in contrast to the fit of the upper body. These observations illustrate how the garments were specifically designed for male shape and proportions, which are characterized by a longer, broader torso, narrower hips, and a taller crotch height (due to taller Stature). On the other hand, females tend to have shorter and narrower torsos, wider hips, and shorter crotch heights (due to shorter Stature).

Two functional fit variables, marching in place and climbing, were both hindered for those who received an unacceptable fit. These two movements were impeded by the low crotch which limited the height to which the knee could be raised. Since climbing is the usual mode of ingress for most combat vehicles, and soldiers march frequently, impediments to either activity are critical. Reaching up and reaching to the side were also problematic for those with an unacceptable fit. Although not specifically evaluated, the armhole depth was observed to be a hindering factor. The armhole was very deep due partly to the dropped shoulder style, but also to a combination of large sleeve and shoulder circumferences designed for male dimensions. The depth of the armhole, coupled with the stiffness of the arm pockets, had a tendency to cause the sleeve to bunch at the subject's upper arm, preventing movement of the fabric over the deltoid bulge to the shoulder. This resulted in the arm being tethered from the upper arm to the middle back. Since full arm extension is often necessary to perform many combat vehicle tasks (loading ammunition, vehicle operation, etc.), as well as regular soldiering tasks, the observed impediment is a problem.

Anthropometric Variables

Analyses performed on the Stature, Weight, Chest Circumference, and Waist Circumference measurements revealed no statistically significant differences ($p < .0125$) between means of those who were accommodated and those who were not, indicating that these anthropometric variables did not influence accommodation.

Proposed Solution: Investigate Development of Female-Specific or Gender-Integrated Sizes

Problems for many subjects were that the back of the garment was too large, and the garment had an excessive leg and torso length. If the coverall is modified to address the problems experienced by the females in this study, it is likely that the fit for males would degrade as a consequence. A fit evaluation of two aviation coveralls (Crist et al., 1995) projected the same outcome, and recommended the development of a separate sizing system for females. However, a separate sizing system may be prohibitively expensive. A possible way to solve these proportional problems in a one-

piece garment is to create a gender-integrated sizing system similar to the Integrated Battle Dress Uniform (Gordon, 1985; McConville et al., 1981). This sizing system used three master patterns: one based on female dimensions for sizes predominantly worn by most females; a second based on male dimensions for sizes predominantly worn by most males; and a third based on both male and female dimensions for sizes worn by smaller males and larger females. Development of an integrated sizing system for the coveralls would require fit and wear tests of males shorter than 5'5" and females taller than 5'5", and would need to include the various layers of the CVC clothing system (CVC Cold Weather Liners, CVC Bib Overall, CVC Cold Weather Jacket, and CVC Body Armor). A research and development program may result, as the Integrated Size BDU system did, in fewer sizes, improved fit, and a net cost savings to the military. A program to accomplish the following goals would be necessary:

1. Determine the number of sizes, the sizing dimensions, and the pattern dimensions
2. Conduct anthropometric fit testing of prototype on all females and smaller males to determine dimensional excesses
3. Conduct static fit test of new sizes on males and females
4. Conduct functional fit and wear test of new sizes

The estimated cost for developing this program is $150K

Mechanics' Coverall

The Mechanics' Coverall is a one-piece garment with long sleeves and a front-entry button placket or hook/pile placket. Button or hook/pile tabs cinch down the garment waist, wrists, and ankles. The coverall is produced in five sizes.

Algorithm for Acceptability

This garment is authorized to be worn over the BDU coat and trouser, but in practice is most often worn over only the BDU trousers and a t-shirt. The garment was evaluated over BDU trousers and a t-shirt on 13 static fit variables and seven functional fit variables. If no more than five static fit variables or no more than three functional fit variables were problematic, the fit of

the coverall was considered acceptable. Using this algorithm, 71.7% of the women who tested the garment were disaccommodated, and thus the garment is considered a problem according to the 15% rule.

Problematic Variables

Overall, the coverall was too loose and long for the majority of subjects (Figure 11). Problematic variables are presented in Table 36.

Table 36. Problematic Mechanics' Coverall Fit Variables

Fit Variable	Overall Fit	
	Acceptable (n=57)	Unacceptable (n=144.6)
Overall Fit	**28.3%**	**71.7%**
Crotch Location		
Satisfactory	10.9%	2.5%
More Than 2" Excess	78.4%	95.9%
Less Than 1" Excess	0.0%	0.0%
Missing	10.7%	1.5%
Shoulder Seam Location		
Satisfactory	52.4%	44.2%
Too Wide	36.9%	55.8%
Missing	10.7%	0.0%
Sleeve Length		
Satisfactory	51.7%	18.4%
Above Knuckles	0.0%	0.5%
Below Knuckles	36.3%	79.1%
Missing	11.9%	2.1%
Chest Fit		
Satisfactory	80.0%	65.7%
Tight	2.7%	6.7%
Loose	6.5%	27.6%
Missing	10.7%	0.0%
Back Fit		
Satisfactory	83.3%	57.1%
Tight	0.0%	1.3%
Loose	6.0%	40.8%
Missing	10.7%	0.8%
Buttock Fit		
Satisfactory	84.0%	69.3%
Tight	0.0%	6.6%
Loose	5.3%	22.2%
Missing	10.7%	1.9%

Table 36 Continued.

Abdomen Fit		
Satisfactory	80.0%	57.6%
Tight	4.8%	18.3%
Loose	4.5%	24.1%
Missing	10.7%	0.0%
Waistband Location		
Satisfactory	64.6%	51.1%
Above Waist 1"	0.0%	2.1%
Below Waist 1"	23.4%	45.6%
Missing	11.9%	1.3%
Leg Length		
Satisfactory	86.9%	51.4%
Contact With Floor	2.4%	48.1%
Missing	10.7%	0.5%
Thigh Pocket Location		
Could Reach Bottom	70.3%	51.2%
Couldn't Reach Bottom	18.9%	48.8%
Missing	10.7%	0.0%
Marching in Place		
Not Hindered	87.5%	59.7%
Hindered	1.8%	40.3%
Missing	10.7%	0.0%
Climbing		
Not Hindered	86.3%	59.2%
Hindered	2.9%	39.9%
Missing	10.7%	0.9%

Static fit variables that were problems, regardless of whether a subject was acceptably fit or not, included the crotch fit, the location of the set-in shoulder seam, and the length of the sleeves. Like the CVC coverall, the garment crotch was too deep for most subjects independent of overall acceptability. Likewise, a set-in shoulder seam is designed to be located within ½" or so of the acromion landmark, but was located too far lateral for most subjects. Correspondingly, the sleeve length had a tendency to be too long as evidenced by the loose cuff flopping over the knuckles of the hand. Contributing to unacceptability was the loose fit of the coverall in the garment chest area, the back, the buttock area, and the abdominal area. Additionally, the location of the waistband was, in general, too low, garment leg length too long, and location of the thigh pocket too low. Although not specifically evaluated, the placket was observed to gape over the bust even when the chest area was not tight.

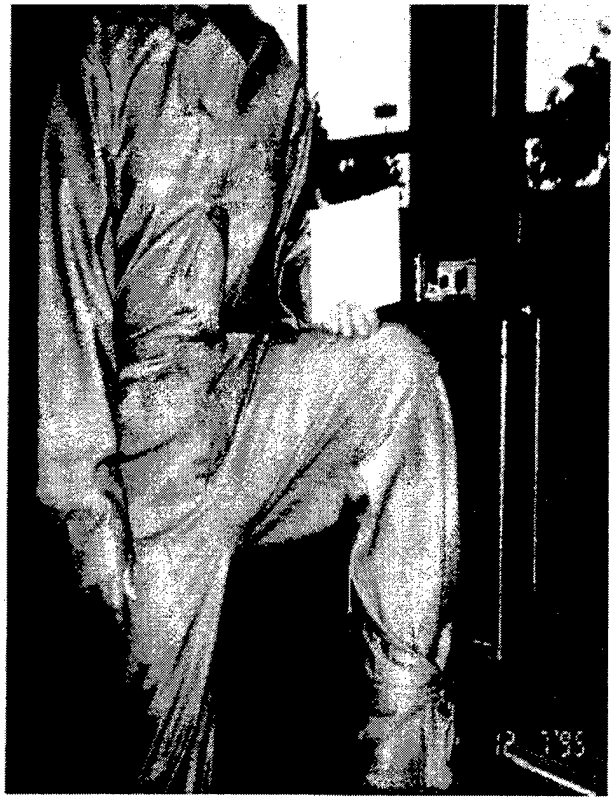

Figure 11
Mechanics' Coverall

The functional fit variables had a tendency to contribute less than the static variables to the acceptability or unacceptability of the coverall's fit; however, those that were problematic are essential activities for the users of the coverall and for the soldier in general. Marching in place and climbing were hindered by the coverall for those who received an unsatisfactory fit. It was observed that the depth of the garment crotch and length of the garment legs were responsible for these hindrances.

AnthropometricVariables

Analyses performed on the Weight, Chest Circumference and Waist Circumference measurements revealed no statistically significant differences ($p < .0125$) between subjects who were accommodated and those who were not. Stature means were analyzed using the Mann Whitney U test because variances were unequal. Stature was found to differ significantly ($p < .0125$) between those who received an acceptable fit and those who did not. Table 37 shows that those who were acceptably fit were, on average, about 12 mm (about 0.5") taller than those who were not fit.

Table 37. Comparison of Significantly Different Anthropometric Variables by Fit of the Mechanics' Coverall

VARIABLE	ACCEPTABLE FIT (n=57.0)		UNACCEPTABLE FIT (n=144.6)	
	Mean	Std. Dev.	Mean	Std. Dev.
Stature (mm)	1581.54	35.75	1569.93	45.47

Proposed Solution: Develop Female or Gender-Integrated Sizes

Like the CVC Coverall, the Mechanics' Coverall was generally too loose in the back and too long throughout the legs, with additional problems of being too wide across the shoulders, too long in the sleeves, and too loose over the bust, buttock, and abdominal areas. The proportional problems due to the male-based design are exacerbated by the paucity of sizes. Since the coverall was generally too big, and no females chose the medium as their best-fitting

size, it is reasonable to assume that smaller size(s) are necessary at the very least, and such sizes should be proportioned for the female body. Since the fit of the coverall is intentionally baggy, the addition of one or two female-specific sizes may be satisfactory. A program to accomplish the following goals would be required:

1. Determine the number of sizes, the sizing dimensions, and the pattern dimensions
2. Conduct anthropometric fit testing of prototype on all females and smaller males to determine dimensional excesses
3. Conduct static fit test of new sizes
4. Conduct functional fit and wear test of new sizes

The Estimated cost to develope female or gender-integrated sizes is $80K

ALICE Pack with External Frame, PASGT VEST, and Tactical Lead-Bearing Vest

All-purpose Lightweight Individual Carrying Equipment (ALICE)
Large Pack with External Frame

This item is comprised of two parts: a one-size, aluminum frame with adjustable, padded shoulder and waist straps, and a large nylon field pack.

Algorithm for Acceptability

The ALICE pack was evaluated over the BDU, PASGT vest, and the Enhanced Tactical Load Bearing Vest (ETLBV) (Figure 12). Six static fit variables and eight functional fit variables were used to assess the fit of the ALICE pack. (The static fit variable regarding the location of the "lumbar" pad was omitted from analysis because the pad is more properly defined as a support pad, and where it supports the load is not necessarily the lumbar region.) The overall fit was judged to be acceptable if no more than two static fit variables were found to be problematic, or if no more than three functions were found to be hindered. Based on these criteria, the fit of the ALICE pack was judged unacceptable for 61.5% of the subjects. Based on the 15% rule established above (Appendix D), the overall fit of this item was considered unacceptable.

Figure 12
ALICE, ETLBV, PASGT Vest

Problematic Variables

As a class, the functional (movement) variables had a tendency to be more problematic than the static fit variables. Problematic variables are presented in Table 38.

Table 38. Problematic ALICE Pack with Frame Fit Variables

Fit Variable	Overall Fit	
	Acceptable (n=77.5)	Unacceptable (n=124.0)
Overall Fit	**38.5%**	**61.5%**
Waistbelt Location w/ PASGT Vest		
Satisfactory	9.1%	3.0%
Above Vest Hem	88.5%	97.0%
Missing	2.4%	0.0%
Climb		
Not Hindered	90.2%	30.8%
Hindered	6.5%	69.2%
Missing	3.3%	0.0%
Reaching Forward		
Not Hindered	60.8%	13.6%
Hindered	35.3%	86.4%
Missing	3.9%	0.0%
Squatting		
Not Hindered	79.9%	24.2%
Hindered	15.3%	75.8%
Missing	4.8%	0.0%
Bend at Waist		
Not Hindered	71.0%	26.5%
Hindered	25.7%	73.5%
Missing	3.3%	0.0%
Reach Up		
Not Hindered	77.1%	32.8%
Hindered	20.5%	67.2%
Missing	2.4%	0.0%

Those who did not receive an acceptable fit were hindered while reaching forward, squatting, bending at the waist, climbing, and reaching up. The location of the waist belt with respect to the PASGT vest was not satisfactory for a majority of subjects, independent of overall

fit acceptability. However, the findings may be misleading since it was found that the term "waist" really referred to a male waist, which designers define at the same level as hipline (the level of the iliac crest). Thus, the term "waist" is interpreted to mean "hip", and does not describe the intended location of the belt at the female waist. However, discussion with the project officer revealed that it does not matter where the belt is located, as long as the belt is supported by the body; but for best integration with the PASGT vest, the belt of the pack should fall below the vest's lower edge. The PASGT vest is intended to extend below the waist to protect vital organs. Since it is a largely male-based sizing system, the length for most vest sizes is designed to extend below the level of the male hip. On the female soldiers in this study, the belt rested above the lower edge of the PASGT vest but below the waist. While this shows that the pack belt did not integrate well with the PASGT vest, it does not necessarily mean that the pack load is not well supported, as there are no data to advocate one belt position over another (personal communication, Kirk, 1996).

The bulk of the PASGT vest shoulder pads and the ETLBV shoulder pads layered on top of the padded shoulder straps of the ALICE pack appeared to prevent forward arm extension. The length of the frame, as well as of the PASGT vest, appeared to impede squatting and bending forward at the waist. For both movements, the stiff PASGT vest would prop against the thighs to push both its collar and the pack frame upward into the back of the head. The propensity for the frame to contact the head when squatting or bending indicates that the frame may be too long for shorter soldiers.

Anthropometeric Variables

Analyses showed that means for Stature were significantly different ($p < .05/4$ variables$=p < .0125$) between the acceptably fit group and the unacceptably fit group. Those who were unacceptably fit were shorter, on average, by approximately 17 mm (0.7") (Table 39).

Table 39. Significantly Different Anthropometric Variables by Fit of the ALICE Pack With Frame

VARIABLE	ACCEPTABLE FIT (n=77.5)		UNACCEPTABLE FIT (n=124.0)	
	Mean	Std. Dev.	Mean	Std. Dev.
Stature (mm)	1587.12	36.05	1569.58	47.30

PASGT Vest

The PASGT vest is a front-opening garment incorporating a 3/4 stand-up collar, and pivoting shoulder pads. The vest extends from the neck down over the abdominal area to protect vital organs. It is available in five sizes; the Extra-Small and Small are intended to accommodate females in that the cut is somewhat flared to allow for the larger female buttock and abdomen.

Algorithm for Acceptability

The PASGT vest was evaluated on the basis of six static fit variables and eight functional fit variables. If no more than two static or no more than two functional fit variables were found to be problematic, the fit of the PASGT vest was deemed acceptable. Using this algorithm, 43.1% of the subjects did not receive an acceptable fit in the PASGT vest, and using the 15% criteria, the vest is considered to be a problem. The acceptability of fit was dependent on the vest size, as described below.

Problematic Variables

In general, the length of the PASGT vest hindered many movements (Figure 13). Problematic variables are presented in Table 40.

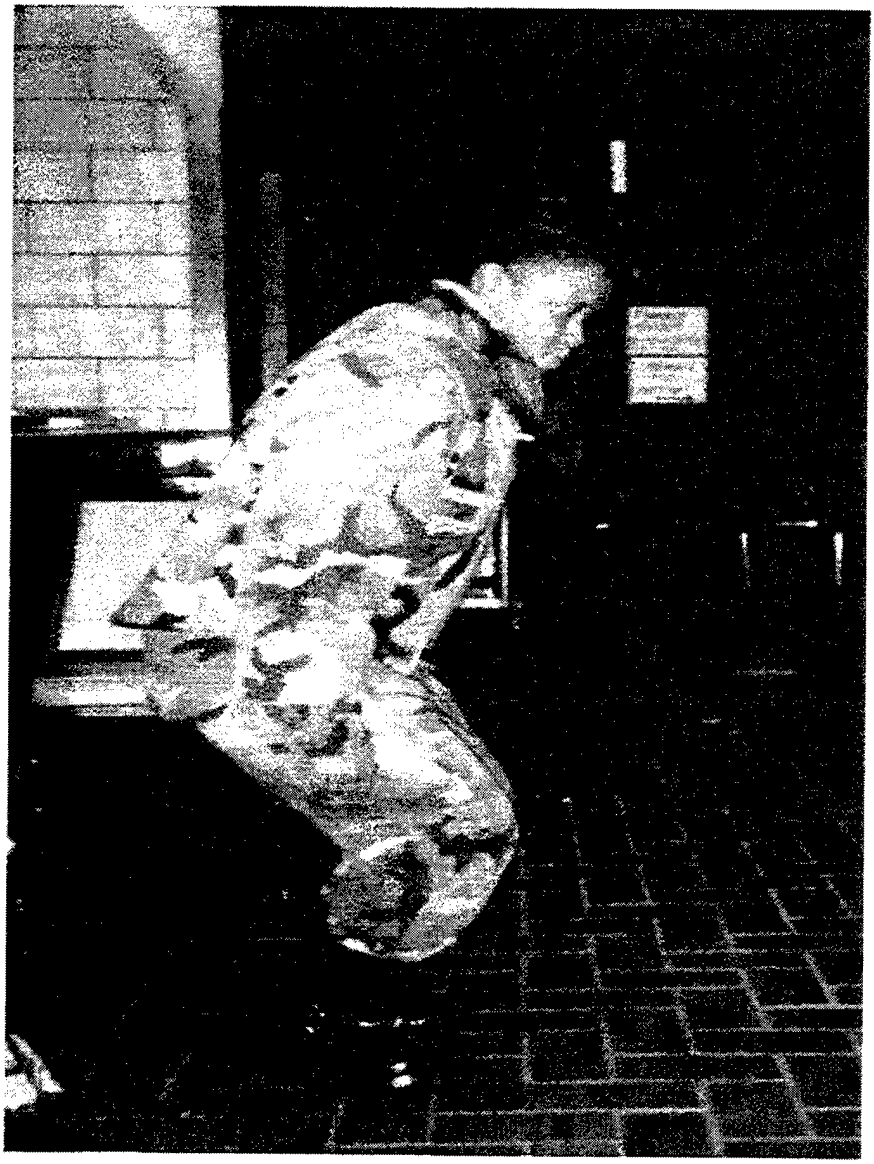

Figure 13
PASGT Vest

Table 40. Problematic PASGT Vest Fit Variables

Fit Variable	Overall Fit	
	Acceptable (n=114.6)	Unacceptable (n=87)
Overall Fit	**56.9%**	**43.1%**
Waist Length		
Satisfactory	0.6%	0.8%
Above Waistline	0.0%	1.4%
Below Waistline	98.8%	97.9%
Missing	0.6%	0.0%
Vest Slippage		
Minimal	59.8%	45.1%
Vertical Displacement	28.8%	27.9%
Horizontal Displacement	3.7%	10.7%
Both Vertical and Horizontal	6.2%	14.2%
Missing	1.6%	2.1%
Bend at Waist		
Not Hindered	67.5%	7.7%
Hindered	30.9%	92.3%
Missing	1.6%	0.0%
Squatting		
Not Hindered	80.8%	14.9%
Hindered	16.9%	85.1%
Missing	2.2%	0.0%
Reach Up		
Not Hindered	80.2%	21.9%
Hindered	18.2%	78.1%
Missing	1.6%	0.0%
Reach Forward		
Not Hindered	83.3%	37.7%
Hindered	15.1%	62.3%
Missing	1.6%	0.0%
Climb		
Not Hindered	97.2%	47.8%
Hindered	0.6%	52.2%
Missing	2.2%	0.0%

A specific problem for all subjects, regardless of the overall fit of the vest, was the length of the vest. The vest extended below the waistline on almost all subjects. The extension of vest below the waistline is a problem because the belts of the ETLBV and ALICE fall in that region. When the PASGT vest extends below the waist, the other belts are forced lower, which can adversely affect comfort and mobility. However, the vest length is intended to provide vital coverage for the abdominal organs and cannot be shortened just to accommodate belts of other items. On the other hand, the length is not compatible with the ALICE pack, as discussed above; compatibility with the ETLBV is discussed below.

Compounding the length problem was the excessive slippage of the vest. The predicted size, which is based on an individual's Chest Circumference, was often uncomfortably tight across the bust. The disaccommodation of the female bust illustrates that the vest was designed for the relatively flat male chest. The next larger size, however, was often too wide in all the other areas. A loose-fitting vest can be dangerous, in that vital areas of the body can be inadvertently exposed, and items worn over the vest can shift out of position, compromising safety and efficiency.

Many functions were hindered for those who received an unacceptable fit; bending at the waist, squatting, reaching up, reaching forward, and climbing. As described above in the ALICE section, when bending, squatting, or climbing, the PASGT vest had a tendency to ride up on the thighs (due to its excessive length) and, because it fit loosely, shifted upward so that the collar pushed up against the ears and back of the head. With the vest wedged between the thigh and head, the stiffness of the vest further interfered with bending, squatting and climbing movements, preventing completion of the task. Reaching up and forward was hindered by the bulk of the vest's shoulder pad, which would wedge between the neck and shoulder, preventing full mobility of the shoulder joint.

Anthropometric Variables

There were no statistically significant differences ($p < .0125$) between those who were acceptably fit and those who were not on the four anthropometric variables.

Enhanced Tactical Load Bearing Vest (ETLBV)

This one-size item incorporates a nylon mesh structure with adjustable shoulder and chest straps, a webbing utility belt, and padded shoulders. It provides pockets and clips to transport ammunition and other equipment.

Algorithm for Acceptability

The ETLBV was evaluated over the BDU and PASGT vest. Six static fit variables and eight functional fit variables were used to evaluate the fit. If no more than two static or two functional fit variables were found to be problematic, the fit of the vest was considered to be acceptable. Using the 15% rule, the ETLBV qualifies as a problem because the fit was found to be unacceptable on 29% of the sample.

Problematic Variables

In general, the length of the ETLBV hindered many movements (Figure 12). Table 41 lists the problematic variables.

Table 41. Problematic ETLBV Fit Variables

Fit Variable	Overall Fit	
	Acceptable (n=143.1)	Unacceptable (n=58.5)
Overall Fit	**71.0%**	**29.0%**
Chest Strap location		
Satisfactory	28.6%	13.0%
At Bustline	57.8%	65.2%
Below Bustline	12.3%	21.8%
Missing	1.3%	0.0%
Equipment Belt Location		
Satisfactory	2.5%	2.0%
Above Waistline	0.0%	2.0%
Below Waistline	97.0%	96.0%
Missing	0.5%	0.0%
Bend at Waist		
Not Hindered	82.3%	4.9%
Hindered	16.0%	95.1%
Missing	1.8%	0.0%
Squatting		
Not Hindered	81.7%	0.0%
Hindered	16.5%	100.0%
Missing	1.8%	0.0%
Climb		
Not Hindered	90.8%	9.8%
Hindered	7.4%	90.2%
Missing	1.8%	0.0%
March in Place		
Not Hindered	97.8%	41.1%
Hindered	0.5%	58.9%
Missing	1.8%	0.0%

The chest strap was found to rest too low whether or not the vest as a whole was acceptable or unacceptable. On most subjects, the top chest strap rested at or below the bust. For women, a chest strap located at the bust or below is uncomfortable, unstable, and presents an unmilitary appearance. The waist belt could be adjusted so that it was positioned below the PASGT vest hem

as intended. However, the resultant location was below the natural waistline for both those who obtained an acceptable fit and those who did not. There are no data to recommend one waist belt location over another, and both are probably acceptable as long as the load is supported.

Functional fit variables that were problematic for those who received an unacceptable fit included squatting, bending at the waist, climbing, and marching in place. During the performance of these movements, the width of the waist belt appears to have exacerbated the problems associated with the length of the PASGT vest described above. The bulk of the ETLBV vest and the PASGT vest hindered movements that involved raising the knee, with the additional discomfort of the sharp belt edge cutting into the thighs. Again, the belt was only as low as it was because of the requirement that it be worn below the PASGT vest hem. Reportedly, many soldiers do not wear the PASGT vest under the ETLBV during training missions because it is hot and uncomfortable. During an informal fit test without the PASGT vest, the ETLBV was adjusted successfully to provide an acceptable lengthwise fit, but the adjustment straps were shortened to their limits, which caused the ammunition pockets to be located too high on the bust to be easily accessible or stable. Furthermore, without the added bulk of the PASGT vest, the ETLBV could not be snugged down properly.

Anthropometric Variables

Stature, Chest Circumference, and Weight means were significantly different ($p < .0125$) for subjects who received a satisfactory fit compared with those who did not, indicating that these variables influenced the acceptability of fit. There were no statistically significant differences between the Waist Circumference means of those who were acceptably fit and those who were not. Table 42 presents the means and standard deviations for the significantly different anthropometric variables.

Table 42. Significantly Different Anthropometric Variables by Fit of ETLBV

VARIABLE	ACCEPTABLE FIT (n=143.1)		UNACCEPTABLE FIT (n=58.5)	
	Mean	Std. Dev.	Mean	Std. Dev.
Stature (mm)	1583.56	39.33	1558.62	49.99
Chest Circumference (mm)	911.95	63.99	941.55	75.04
Weight (Kg)	60.05	8.57	60.40	8.63

On average, those who received an unacceptable fit were 24.94 mm (about 1") shorter in height and 29.6 mm (about 1.2") larger in the chest than those who received an acceptable fit. It is probable that the dimensions of the best fitting size of the PASGT vest are indirectly responsible for this. Female subjects with larger bust sizes would have worn a larger size PASGT with a correspondingly longer length; the ETLBV would have been adjusted longer as well, resulting in the related mobility problems noted above.

Proposed Solution: Systems Engineer Female or Gender-Integrated Sizes

Many of the functions that were impeded appear to be related to an unsatisfactory interface among the PASGT vest, the ALICE pack, and the ETLBV. In fact, 75.5% of the subjects who were unacceptably fit in the ALICE also reported that the pack was incompatible with the items worn underneath (PASGT vest and ETLBV). The length of the PASGT vest seemed to have had a domino effect on the fit of the items worn over it (ETLBV and the ALICE). The PASGT vest length was incompatible with the waist belt of the ALICE pack. The ETLBV belt, once adjusted to the level of the PASGT hem, exacerbated the mobility problems noted above. In addition to the integration problems, each item had its own unique fit problems.

Natick designers have long been aware of the female-specific fit and integration problems of these three items. A new Modular Body Armor/Modular Load System program (electronic communication, Chignola, March 1996), will be developing a replacement for the PASGT vest (anticipated fielding by FY99). The requirements are to fit the 5th female-95th male percentile for

key sizing dimensions. The armor coverage should provide a balance between organ protection and mobility. A separate program has been proposed for FY97-98 to define: 1) the vital organ vulnerability and body surface exposure of Army women as a function of armor size and shape; 2) the characteristics of armor size and fit that restrict mobility; and 3) the feasibility of accommodating male and female soldiers with the same sizing system.

The present study yielded some findings that may be helpful to developers of the new armor and load carrying items. Armor vest length appeared to drive many of the problems. Shortening the armor length for compatibility with the female upper body will be necessary. Contouring the armor front to accommodate the female bust may be necessary to prevent the issuing of unnecessarily large and long vests. The ALICE frame was excessively long for the female torso, and so the new load bearing systems will require a shorter length or adjustable frame.

A possible consequence of shortening the length of any component is the corresponding decrease in the surface stowage area. For example, shortening the load bearing system may require relocation of the pockets so that they are not placed too high to be accessible, and so that items requiring stable carriage are not located on the bust. There may not, however, be enough room on the female torso to enable these relocations. Another example of the limitation of female torso surface area is the shortening of the pack frame, which decreases the amount of surface area of the back supporting the pack load. Assuming that the volume of the pack and the weight of its contents will not be changed, the load will be forced further aft. The soldier's center of gravity will consequently be displaced backward, increasing the moment about the pivot point of the soldier's back. The biomechanical repercussions may include a greater risk of back injuries and premature fatigue. Proposed solutions should be evaluated with regard to the consequences of reduced surface area.

Estimated cost of female body armor program proposal: $178k per manyear for two manyears.

Extended Cold Weather Clothing System (ECWCS) Parka

The hooded parka has a two-way front zipper which extends from the eye level to hem; snow skirt (inner elasticized waist panel that snaps closed); hook/pile wrist tabs; underarm zippers; chest pockets and cargo pockets. The parka is produced in 17 sizes. It is designed to be worn over polypropylene long underwear, fiberpile bib overall and shirt, quilted coat and trouser liners, and PASGT helmet, but the parka can be worn over the BDU alone. The parka was tested here over the polypropylene underwear and fiberpile shirt and trousers.

Algorithm for Acceptability

Thirteen static fit and eight functional fit variables were assessed. If no more than five static fit or three functional fit variables were found problematic, the item overall, was judged to be acceptable. Using this algorithm, 26.5% of the subjects were disaccommodated.

Problematic Variables

In general, the parka was too tight through the body, too long in the sleeves, and too large in the hood (Figure 14). Problematic variables are presented in Table 43.

Table 43. Problematic ECWCS Parka Fit Variables

Fit Variable	Overall Fit	
	Acceptable (n=148.1)	Unacceptable (n=53.5)
Overall Fit	**73.5%**	**26.5%**
Sleeve Length		
Satisfactory	44.0%	7.3%
Below Knuckles	52.1%	91.4%
Missing	3.9%	1.3%
Visor Location		
Satisfactory	60.5%	43.9%
Obstructs Vision	33.5%	56.1%
Missing	5.9%	0.0%

Table 43 Continued

Snow Skirt Location		
Satisfactory	74.5%	54.6%
Above Waistline	0.9%	1.3%
Below Waistline	2.2%	44.1%
Missing	3.4%	0.0%
Snow Skirt Fit		
Satisfactory	72.2%	44.1%
Tight	13.2%	54.6%
Missing	14.6%	1.3%
Turn Head		
Visor Stays With Head	33.1%	42.4%
Visor Stays Put, Obstructs Vision	56.2%	54.2%
Missing	10.7%	3.4%

For most of the subjects (n=163) the best-fitting size was larger than the predicted size because of excessive tightness at the waist and hips. Sleeve length was the biggest problem for most subjects, whether the overall fit was acceptable or not; 91.4% of those who were unacceptably fit and 52.1% of those acceptably fit found that the cuffed sleeves extended beyond the knuckles of the hand. The next most unsatisfactory area for those who were disaccommodated was the fit of the hood over the head without the helmet. The hood visor obstructed vision, and the looseness of the hood allowed subjects' bare heads to rotate so freely within it that they ended up looking at the inside of the hood. The location of the snow skirt was below the waistline (usually located over the buttocks), and consequently, too tight for those disaccommodated.

Anthropometric Variables

There were no significant anthropometric differences between the subjects who received an acceptable fit and those who did not. This indicates that body size did not influence the acceptability of fit.

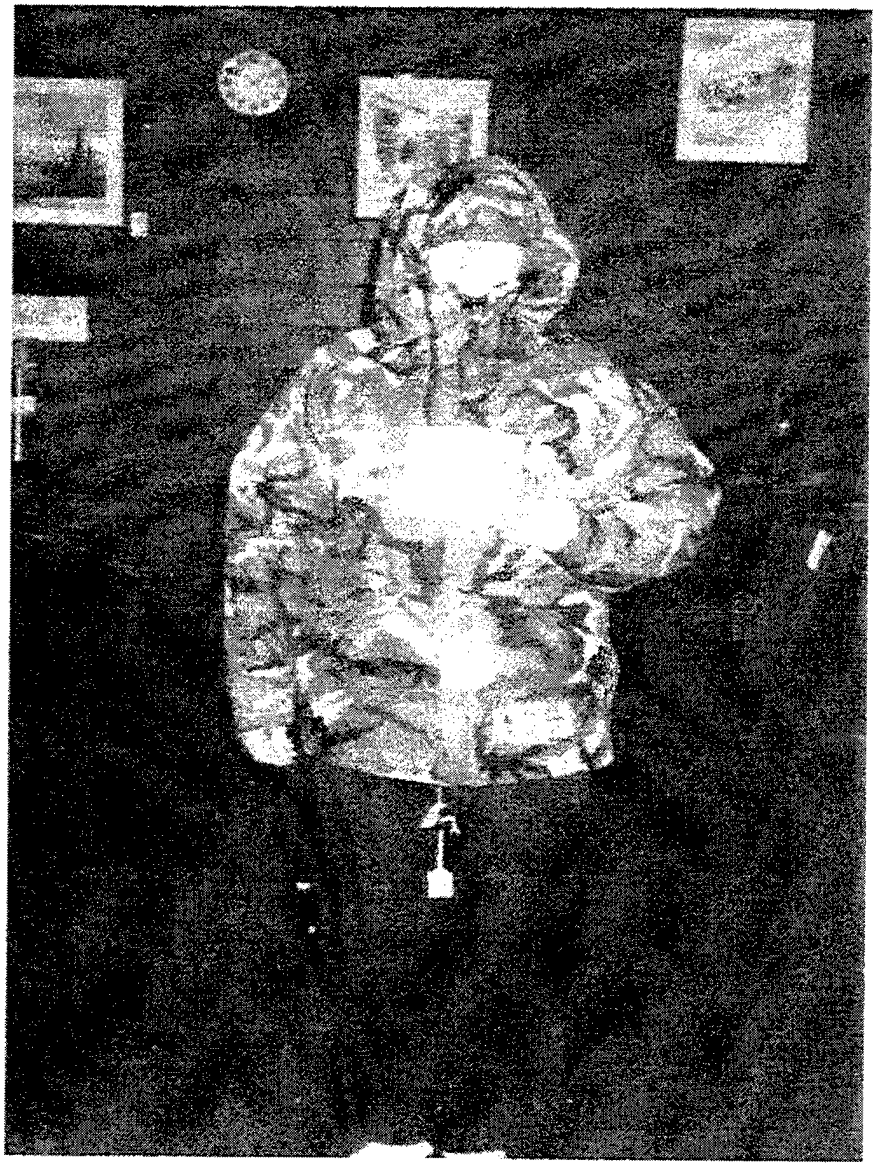

Figure 14
ECWCS Parka (1GEN)

Proposed Solution: Hood Redesign Already Being Addressed; Field Modify Snow Skirt; Redesign Sleeve Length

The hood was found to be too loose for many subjects. The hood was sized to accommodate a helmet, and the way the visor is stitched to the hood limits the extent to which the drawstrings can be cinched to close up the hood opening. Since a snug fit around the face was not possible, the hood did not rotate with the head, and the hood obstructed vision when the head was turned. Additionally, the visor drooped over the eyes and obstructed vision. A second generation ECWCS parka is currently being developed; its hood has been redesigned to allow the drawstrings to tighten continuously around the face. The visor has also been redesigned and appears to be shorter than that evaluated.

The location of the snow skirt appeared to be below the subjects' natural waistline, and thus extended over the larger abdominal/buttock area. Because the elastic was stretched to its limits, the snow skirt curled over itself at the abdomen so that it came to rest at the smaller girth of the waist. The snow skirt would appear to be located too low for the females in this study. However, if the snow skirt were higher, it may not fit longer-waisted male soldiers or taller females. It is suggested that the snow skirt be allowed to flip up and down freely, thus providing two locations. Snaps could be added to the reverse of the front edges of the snow skirt for closure in the flipped-up position, and while not necessarily located over the waistlines of all wearers, the redesign may at least increase accommodation.

The excessive length of the parka sleeves may require modification of the patterns to accommodate females. Snaps could be added to the current version of the parka to reduce the extra length of the sleeve cuffs by snapping the folded cuff backward (the cuff is too stiff for folding alone to work). The developmental parka sleeves cannot be folded backward because of the new unlined construction and the addition of a stiff moisture proof coating which prevents folding. It appears that length can be altered only by changing the patterns to make the sleeve shorter.

To implement the suggestions above, the following steps would be required:

1. Develop prototype modified snow skirt and sleeve
2. Conduct small scale fit test on female soldiers
3. Document authorized equipment modification and changes to technical drawings

The estimated cost for Hood Redesign is: $50K

Wet Weather Trousers

The Wet Weather Trousers are ankle-length with a drawcord in each hem casing, pass-through pocket openings, suspender loops, waist-to-crotch fly front with no zipper, and a waist drawcord. The trousers are produced in five sizes. In this study, the best-fitting Wet Weather Trousers were evaluated over the Standard BDU trousers.

Algorithm for Acceptability

If any three static fit variables or any two functional fit variables were problematic, the fit of the trousers was considered unacceptable. Using this algorithm, 15.5% of the subjects were disaccommodated, qualifying the trousers as a problematic item.

Problematic Variables

In general, the best-fitting size was too long and too baggy. Of those subjects who were unacceptably fit, 49.2% found the crotch length excessive, 36.8% found the abdomen area too loose, and 27.1% found the buttock too loose. In contrast, the waist area was not found to be baggy, but the waist cord length was inadequate for 28.1% of the subjects disaccommodated. More serious were the impediments to mobility. A large proportion of the sample found that climbing, marching in place, and squatting were hindered. Problematic variables are presented in Table 44.

Table 44. Problematic Wet Weather Trouser Fit Variables

Fit Variable	Overall Fit	
	Acceptable (n=170)	Unacceptable (n=31.3)
Overall Fit	**84.5%**	**15.5%**
Buttock Fit		
Satisfactory	88.1%	59.4%
Tight	3.7%	13.5%
Loose	5.8%	27.1%
Missing	2.4%	0.0%
Abdomen Fit		
Satisfactory	81.4%	44.2%
Tight	3.5%	19.0%
Loose	11.4%	36.8%
Missing	3.7%	0.0%
Crotch Fit		
Satisfactory	75.3%	47.0%
More Than 2" Excess	22.3%	49.2%
Missing	2.4%	3.8%
Waist Cord Length		
Not Too Short	82.8%	68.1%
Too Short To Be Tied	14.8%	28.1%
Missing	2.4%	3.8%
March in Place		
Not Hindered	96.3%	54.0%
Hindered	1.3%	46.0%
Missing	2.4%	0.0%
Squatting		
Not Hindered	89.4%	66.1%
Hindered	5.2%	31.7%
Missing	5.4%	2.2%
Climbing	91.1%	34.0%
Not Hindered	6.5%	63.8%
Hindered	2.4%	2.2%
Missing		

Anthropometric Variables

Those who received an acceptable fit were not significantly different in terms of body size variables than those who did not receive an acceptable fit.

Proposed Solution: Provide Suspenders

The most serious problems were the impediments to climbing, marching, and squatting, excessive crotch length, and abdomen fit. As with other garments tested, the excessive crotch length likely restricted raising of the knee; the frictional resistance of the trouser's poplyurethane coated nylon against the fabric of the BDU may also have contributed to hindering movement. Shortening the crotch length by modification of pattern pieces or by wearing suspenders may alleviate some impedance, but reducing the frictional resistance should also be explored. A developmental item, the Improved Rainsuit, uses a semi-permeable coated nylon and should be evaluated for impediments to mobility. The fit of the abdomen can be improved only by redesigning the pattern so that more fullness is allowed in the front. The following steps would be required to implement these suggestions:

1. Determine ease required in abdominal area
2. Conduct static fit and functional fit test of redesigned abdomen area prototypes
3. Conduct functional fit test of Improved Rainsuit

The estimated cost to provide suspenders is: $80K

V. CONCLUSIONS

One workstation representing each of six occupational areas as well as 11 clothing and individual equipment (CIE) items were assessed for compatibility with the anthropometry of female soldiers 5'5" and shorter in height. Every workstation disaccommodated the subjects in this study in at least one aspect. The task with the highest difficulty rating was reaching the V7 valve in the M978 HEMTT, and the workstation with the most problems was the Mobile Kitchen Trailer. Of the 11 CIE items, only three (Light Duty Work Gloves, PASGT Helmet, and the MC1-1 Parachute Harness) were found to provide an acceptable fit for the females in this study. The items posing the most severe fit problems for a majority of females in this study were the CW Trigger Finger Mitten, the CVC Coverall, the Mechanics' Coverall, and the ALICE pack with frame.

Anthropometric Variables

Disaccommodation in workstations and in CIE was found to be independent of whether a subject exceeded the Army's "Weight-for-Height" standard, but was often related to anthropometric variables, especially those related to Stature. Table 45 presents a summary of the Stature means found to be statistically significant for problematic variables.

Table 45. Summary of Significantly Different Stature Means (mm) for Problematic Items

Problematic Workstation	Stature Mean of Acceptable Group	Stature Mean of Unacceptable Group
MKT Install Utensil Holder	1615.75	1567.77
MKT Replace Fire Extinguisher	1604.65	1559.97
MKT Lower Range Cover	1591.52	1556.97
HEMTT Reach V7	1629.43	1576.30
HEMTT Close Rear Hatch	1596.10	1520.47
M1070 HET Close Hood	1599.98	1574.10
M10A Forklift Sight Objects at Fork Ends	1587.00	1538.25
M577 Vision out of Hatch	1590.99	1540.48
MEAN	**1604.06**	**1556.57**
Problematic CIE Item		
CW Trigger Finger Mitten	1615.93	1574.73
Mechanics' Coverall	1581.54	1569.93
ALICE Frame and Pack	1587.12	1569.58
ETLBV	1583.56	1558.62
MEAN	**1592.04**	**1568.22**

It appears that females who were, on average, about 5'3" and taller in Stature were accommodated by the workstations and CIE items chosen for this evaluation. In contrast, those females about 5'2" and shorter on average were disaccommodated. This finding suggests that the establishment of entry requirements based on body size for some Army MOSs may help ensure that soldiers are accommodated until equipment is modified or redesigned for use by shorter individuals.

Increasing the accommodation of the female soldiers in the workstations studied should increase the safety of task performance and increase the numbers of available soldiers who can be assigned a particular task. It is likely that males of a shorter Stature also experience the reach

problems observed for the females in this study. With the increasing numbers of minority groups characterized by shorter Stature and reach dimensions (e.g., Hispanics and Asian/Pacific Islanders), the influx of shorter individuals will likely increase over time.

Improving the fit of CIE for females will not only enhance task performance, but will also address the difference in expectations between males and females of what comprises a military appearance. This study found that, for some items, female soldiers could only obtain, or felt obligated to choose, loose-fitting clothing, despite the U.S. Army's Technical Manual TM 10-227 (1994) ("Fitting of Army Uniforms and Footwear") instruction that smooth fit without excessive looseness (or tightness) is desirable. Specifically, female soldiers in this study indicated that snug-fitting garments were seen as "provocative". (In fact, females are instructed not to wear the BDU t-shirt without the BDU coat over the top, since the t-shirt is form revealing). The females in this study indicated that a loose fit was more "military" than a snug fit, even if the looseness was excessive and the tighter garment more functional. In this study, tightness was often a result of the male-proportioned design being applied to the female form. Properly sized and proportioned CIE should provide a military appearance in terms of avoiding excessive tightness or looseness, as well as satisfy the tacit expectation to avoid form-revealing fit.

Using the recommendations included in this report, Table 46 summarizes the suggested retrofits and the cost of their implementation to the U.S. Army. This study was requested to indicate the scope of the potential disaccomodation problem in the U.S. Army. Extrapolating these costs across the entire spectrum of equipment with which a female soldier could interact may result in inaccurate conclusions, and thus the data should only be used to set absolute minimum costs. With respect to the cost estimates for the clothing and individual equipment in particular, it should be noted that the expense of generating and/or modifying procurement contracts which would increase the number of sizes for items (and therefore, the number of NSNs) is not accounted for. Similarly, the cost of maintaining additional NSNs in the military distribution system has not been included in the estimates presented here.

Table 46 Summary of Retrofit Costs

EQUIPMENT ITEM	SUGGESTED RETROFIT(s)	ESTIMATED COST OF RETROFITS
WORKSTATIONS		
Mobile Kitchen Trailer (MKT75)	Relocate fire extinguisher, install battery powered lighting, replace range cover prop hardware	$3.3mil
HEMTT Fuel Tanker (M978)	Install strap pull on rear hatch	$125k
Heavy Equipment Transporter (M1070)	TBD	TBD
10K FORKLIFT (M10A)	Install convex mirror	$126k
LIGHT TRACKED COMMAND POST VEHICLE (M577)	Reposition seat post, reposition accelerator	$152k
CLOTHING/INDIVIDUAL EQUIPMENT		
CW Trigger Finger Mitten	Add smaller size(s)	$50k
CVC Coverall	Investigate female specific/ integrated sizes	$150k
Mechanics' Coverall	Investigate female specific/integrated sizes	$80k
ALICE, ETLBV, PASGT	Ballistic Protection Program for Modular Body Armor/Load Bearing Program	$356k
ECWCS Parka	Authorize field modifications	$50k
Wet Weather Trousers	Suspenders, pattern change	$80k
ESTIMATED TOTAL ARMY COST		**$4.5mil**

This document reports research undertaken at the U.S. Army Soldier Systems Command, Natick Research, Development and Engineerin Center and has been assigned No. NATICK/TR-97/017 in the series of repor approved for publication.

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APPENDIX A
Description of Anthropometric Measurements

Description of Anthropometric Measurements
(In alphabetical order)

Chest Circumference: The maximum horizontal circumference of the chest at the fullest part of the breast is measured with a tape. The subject stands erect, looking straight ahead. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

Crotch Height: The vertical distance between the standing surface and the crotch is measured with an anthropometer. The subject stands erect looking straight ahead. The heels are together and the weight is distributed equally on both feet.

Eye Height, Sitting: The vertical distance between a sitting surface and the ectocanthus landmark on the outer corner of the right eye is measured with an anthropometer. The subject sits erect with the head in the Frankfort plane. The shoulders and upper arms are relaxed and the forearms and hands are extended forward horizontally with the palms facing each other. The thighs are parallel and the knees are flexed 90 degrees with the feet in line with the thighs. The measurements are taken at the maximum point of quiet respiration.

Functional Leg Length: The straight-line distance between the plane of the bottom of the right foot with the leg extended and the back of the body of a seated subject is measured with an anthropometer passing over the trochanter landmark on the side of the hip. The subject sits erect on a stool 40.8 cm high. The right leg is extended and the foot is on the base plate of the anthropometer, which rests on the floor. The measurement is made from the footrest surface of the base plate.

Hand Circumference: The circumference of the right hand is measured with a tape passing over the landmarks at metacarpal II and metacarpal V. The subject places the palm on a table, the fingers together, and the thumb abducted. The middle finger is parallel to the long axis of the forearm. The two distal phalanges of the fingers lie on a flat surface 8 mm higher than the table surface.

Hand Length: The length of the right hand between the style landmark on the wrist and the tip of the finger is measured with a Poech sliding caliper. The subject places the palm on a table, the fingers together, and the thumb abducted. The middle finger is parallel to the long axis of the forearm. The two distal phalanges of the fingers lie on a flat surface 8 mm higher than the table.

Overhead Fingertip Reach, Extended: The vertical distance between a standing surface and the tip of the right middle finger when the arm is extended overhead as high as possible is measured on a wall scale. The subject stands on his/her toes facing a wall-mounted scale with both arms parallel and extended overhead as high as possible. The toes are 20 cm from the wall and the feet are about 10 cm apart. The palms of the hands rest on the scale. A block is placed against the tip of the finger to establish the measurement. The measurement is taken at the maximum point of quiet respiration.

Popliteal Height: The vertical distance from a footrest surface to the back of the right knee (the popliteal fossa at the dorsal juncture of the right calf and thigh) is measured with an anthropometer. The subject sits with the thighs parallel, the feet in line with the thighs, and the knees flexed 90 degrees.

Stature: The vertical distance from a standing surface to the top of the head is measured with and anthropometer. The subject stands erect with the head in the Frankfort plane. The heels are together with the weight distributed equally on both feet. The shoulders and upper extremities are relaxed. The measurement is taken at the maximum point of quiet respiration.

Thumbtip Reach: The horizontal distance from a back wall to the tip of the right thumb is measured on a wall scale. The subject stands erect in a corner looking straight ahead with the feet together and the heels 20 cm from the back wall. The buttocks and shoulders are against the wall. The right arm and hand, palm down, are stretched froward horizontally along a scale on the side wall. The thumb continues the horizontal line of the arm and the index finger curves around to touch the pad at the end of the thumb. The subject's right shoulder is held against the rear wall.

Waist Circumference: The horizontal circumference of the waist at the level of the natural indentation is measured with a tape passing over right and left (natural indentation) landmarks. The subject stands erect looking straight ahead. The heels are together with the weight equally distributed on both feet. The measurement is made at the maximum point of quiet respiration.

Weight: The weight of the subject is taken to the nearest tenth of a kilogram. The subject stands on the platform of a scale.

APPENDIX B
Results of Statistical Tests to Determine Weighting

STATISTICAL TESTS TO DETERMINE WEIGHTING OF WORKSTATION SAMPLE

UNWEIGHTED SAMPLE BY ANSUR RACE AND AGE GROUPS

	RACE			AGE			BY RACE AND AGE					
VARIABLE	**n**	**Bartlett Box *F***	***p***	**n**	**Bartlett Box *F***	***p***	**MAIN *F***	***p***	**RACE *F***	***p***	**AGE *F***	***p***
Stature	201	2.451	0.032	203	0.578	0.629	6.682	0.000	10.119	0.000	1.622	0.186
Weight (Kg)	200	0.595	0.704	202	0.363	0.780	0.944	0.482	0.527	0.756	1.545	0.204
Crotch Height	201	0.645	0.666	202	0.399	0.754	8.258	0.000	12.448	0.000	1.742	0.160
Overhead Reach, Extende	200	1.660	0.142	202	0.016	0.997	1.123	0.350	0.867	0.504	1.634	0.183
Thumbtip Reach	201	0.642	0.668	202	0.250	0.861	5.954	0.000	7.841	0.000	2.421	0.068
Popliteal Height	200	1.403	0.221	202	0.066	0.978	0.601	0.777	0.548	0.740	0.770	0.512
Functional Leg Length	200	1.306	0.259	200	0.728	0.535	7.851	0.000	11.814	0.000	0.942	0.422
Eye Height	200	0.720	0.608	201	0.807	0.490	1.398	0.200	1.177	0.322	1.452	0.229
Hand Length	201	0.408	0.843	201	1.616	0.184	8.202	0.000	12.252	0.000	0.938	0.424

UNWEIGHTED SAMPLE BY ANSUR RACE AND COLLAPSED AGE GROUPS

	RACE			AGE			BY RACE AND AGE					
VARIABLE	**n**	**Bartlett Box *F***	***p***	**n**	**Bartlett Box *F***	***p***	**MAIN *F***	***p***	**RACE *F***	***p***	**AGE *F***	***p***
Stature	201	2.451	0.032	202	1.205	0.272	7.335	0.000	8.525	0.000	1.873	0.173
Weight (Kg)	200	0.595	0.704	201	0.007	0.936	0.82	0.556	0.538	0.747	2.034	0.155
Crotch Height	201	0.645	0.666	202	0.132	0.716	9.562	0.000	11.151	0.000	0.881	0.349
Overhead Reach, Extende	200	1.660	0.142	202	0.098	0.755	8.628	0.000	9.965	0.000	1.884	0.172
Thumbtip Reach	201	0.642	0.668	201	0.553	0.457	7.242	0.000	7.223	0.000	5.927	0.016
Popliteal Height	200	1.403	0.221	202	0.009	0.924	10.019	0.000	11.911	0.000	0.495	0.482
Functional Leg Length	200	1.306	0.259	200	0.324	0.569	8.819	0.000	10.102	0.000	1.322	0.252
Eye Height	200	0.720	0.608	201	1.830	0.176	12.607	0.000	15.123	0.000	1.169	0.281
Hand Length	201	0.408	0.843	201	1.850	0.174	1.141	0.287	0.708	0.588	0.708	0.588

STATISTICAL TESTS TO DETERMINE WEIGHTING OF WORKSTATION SAMPLE

WEIGHTED SAMPLE BY ANSUR RACE AND AGE GROUPS

	RACE			AGE			BY RACE AND AGE					
VARIABLE	**n**	**Bartlett Box *F***	***p***	**n**	**Bartlett Box *F***	***p***	**MAIN *F***	***p***	**RACE *F***	***p***	**AGE *F***	***p***
Stature	201	2.752	0.027	202	0.000	1.000	4.304	0.000	5.998	0.000	2.092	0.103
Weight (Kg)	200	0.986	0.414	201	0.596	0.618	0.786	0.616	0.283	0.922	1.621	0.186
Crotch Height	201	1.043	0.384	202	0.000	1.000	5.577	0.000	7.541	0.000	2.092	0.103
Overhead Reach, Extende	200	2.014	0.09	201	0.000	1.000	5.488	0.000	6.904	0.000	3.270	0.023
Thumbtip Reach	201	1.044	0.383	202	0.000	1.000	5.357	0.000	6.644	0.000	3.068	0.029
Popliteal Height	200	2.176	0.069	201	0.634	0.593	5.987	0.000	8.074	0.000	2.220	0.088
Functional Leg Length	199	2.482	0.042	200	0.981	0.401	5.262	0.000	7.872	0.000	0.874	0.455
Eye Height	200	1.094	0.358	201	0.101	0.959	9.319	0.000	14.803	0.000	0.832	0.478
Hand Length	200	2.554	0.037	201	1.388	0.245	6.147	0.000	9.687	0.000	0.273	0.845

WEIGHTED SAMPLE BY ANSUR RACE AND COLLAPSED AGE GROUPS

	RACE			AGE			BY RACE AND AGE					
VARIABLE	**n**	**Bartlett Box *F***	***p***	**n**	**Bartlett Box *F***	***p***	**MAIN *F***	***p***	**RACE *F***	***p***	**AGE *F***	***p***
Stature				202	0.000	1.000	3.778	0.001	4.252	0.001	1.594	0.208
Weight (Kg)				201	0.865	0.353	0.588	0.740	0.286	0.920	2.022	0.157
Crotch Height				202	0.000	1.000	5.498	0.000	6.418	0.000	0.798	0.373
Overhead Reach, Extended				201	0.000	1.000	4.341	0.000	4.865	0.000	1.791	0.182
Thumbtip Reach				202	0.000	1.000	6.006	0.000	5.656	0.000	7.243	**0.008**
Popliteal Height				201	1.886	0.170	5.287	0.000	6.263	0.000	0.428	0.514
Functional Leg Length				200	2.425	0.120	5.859	0.000	6.688	0.000	1.424	0.234
Eye Height				201	0.002	0.967	12.238	0.000	14.647	0.000	0.558	0.456
Hand Length				201	1.311	0.252	7.399	0.000	8.683	0.000	0.727	0.395

STATISTICAL TESTS TO DETERMINE WEIGHTING OF CIE SAMPLE

UNWEIGHTED SAMPLE BY ANSUR RACE AND AGE GROUP

	RACE			AGE			BY RACE AND AGE						KRUSKAL WALLIS	
VARIABLE	**n**	**B B *F***	***p***	**n**	**B B *F***	***p***	**MAIN *F***	***p***	**RACE *F***	***p***	**AGE *F***	***p***	***AGE CHI p***	
Weight (Kg)	200	0.595	0.704	202	0.363	0.780	0.944	0.482	0.527	0.756	1.545	0.204	15.038	0.0018
Stature	200	1.057	0.383	198	0.420	0.739	1.524	0.125	1.704	0.136	1.194	0.314		
Chest Circ	200	0.744	0.591	198	1.295	0.275	2.728	0.007	1.952	0.088	3.775	0.012		
Waist Circ	200	0.625	0.681	199	1.112	0.343	4.216	0.000	1.905	0.096	7.632	0.000		

UNWEIGHTED SAMPLE BY ANSUR AGE AND COLLAPSED RACE GROUPS

	RACE			AGE			BY RACE AND AGE							
VARIABLE	**n**	**BB *F***	***p***	**n**	**BB *F***	***p***	**MAIN *F***	***p***	**RACE *F***	***p***	**AGE *F***	***p***	***AGE CHI p***	
Weight	199	1.720	0.147	199	2.865	0.035	4.353	0.000	2.692	0.033	5.602	0.001	15.038	0.0018
Stature	199	1.254	0.286	198	0.420	0.739	1.538	0.157	1.777	0.135	1.035	0.378		
Chest Circ	199	0.615	0.652	198	1.295	0.275	2.922	0.006	2.1	0.083	3.875	0.010		
Waist Circ	200	0.643	0.632	199	1.112	0.343	4.612	0.000	2.034	0.092	7.645	0.000		

WEIGHTED SAMPLE BY ANSUR RACE AND AGE GROUPS

	RACE			AGE			BY RACE AND AGE							
VARIABLE	**n**	**BB *F***	***p***	**n**	**BB *F***	***p***	**MAIN *F***	***p***	**RACE *F***	***p***	**AGE *F***	***p***	***AGE CHI p***	
Weight	198	2.051	0.085	197	3.054	0.027	4.558	0.000	1.643	0.151	9.665	0.000	22.608	0.0000
Stature	198	1.902	0.107	197	0.910	0.435	1.766	0.087	1.117	0.353	3.021	0.031		
Chest Circ	198	1.414	0.227	197	3.011	0.029	3.253	0.002	1.225	0.299	6.962	0.000	18.511	0.0003
Waist Circ	198	1.207	0.306	197	3.262	0.021	4.725	0.000	0.962	0.443	11.242	0.000	34.741	0.0000

STATISTICAL TESTS TO DETERMINE WEIGHTING OF CIE SAMPLE

WEIGHTED SAMPLE BY ANSUR AGE AND COLLAPSED RACE GROUPS

	RACE			AGE			BY RACE AND AGE							
VARIABLE	**n**	**BB *F***	***p***	**n**	**BB *F***	***p***	**MAIN *F***	***p***	**RACE *F***	***p***	**AGE *F***	***p***	***AGE CHI p***	
Weight	199	0.916	0.456	198	3.266	0.021	5.658	0.000	2.38	0.053	10.329	0.000	24.570	0.0000
Stature	199	0.514	0.725	197	0.457	0.712	1.976	0.061	1.356	0.251	2.953	0.034		
Chest Circ	199	0.451	0.772	197	2.452	0.062	3.983	0.000	1.72	0.147	7.379	0.000	24.158	0.000
Waist Circ	198	0.26	0.904	198	2.738	0.042	5.731	0.000	1.443	0.222	11.732	0.000	27.453	0.000

APPENDIX C
Data Collection Sheets

A.C.C.E.S.S.
ARMY CREWSTATION, CLOTHING, AND EQUIPMENT SYSTEMS STUDY

BIOGRAPHICAL DATA: MILITARY HISTORY

PRIVACY ACT STATEMENT

AUTHORITY:	**5 U.S.C. 301, 301,10 U.S.C. 1071-1090, 44 U.S.C. 3101, E.O. 9397, and Chapter 14-4, DA PAM 25-51.**
PURPOSE:	**To permit the collection of anthropometric and ergonomic data in accordance with a study which will be used to determine the accommodation of Army females in current Army sizing systems.**
ROUTINE USES:	**Information gathered during this study will be used to modify workstations for Army personnel.**
DISCLOSURE:	**Voluntary, however, failure to furnish the information requested may result in the volunteer's removal from further participation in this study.**

SUBJECT NO. _____ _____ _____ _____

INITIALS: _____

TODAY'S DATE: _____ _____ - 95 (e.g., 03-28-95)
(month) (day)

ARMY POST: _____ [1] _____ [2]

MILITARY DUTY TYPE:

_____ [1]ACTIVE _____ [2]RESERVE _____ [3]NATIONAL GUARD

RANK: E- _____ O - _____ WO - _____

TIME IN SERVICE: _____ Years _____ Months

OCCUPATION CODE: _____

OCCUPATION TITLE: _____

AGE: _____

SEX: _____[1]M _____[2]F

RACE _____ [1]WHITE _____ [4]ASIAN/PACIFIC ISLANDER

_____ [2]BLACK _____ [5]AMERICAN INDIAN/ALASKAN NATIVE

_____ [3]HISPANIC _____ [6]MIXED OR OTHER (_____)

SUBJECT INITIALS: _____

SUBJECT NO._____ ____ ____ ___

WORKSTATION MEASUREMENTS

							COMMENT
1.	WEIGHT			.		Kg	
2.	STATURE					mm	
3.	CROTCH HEIGHT	X				mm	
4.	OVERHEAD REACH EXTENDED	X				mm	
5.	THUMBTIP REACH	X				mm	
6.	POPLITEAL HEIGHT	X				mm	
7.	EYE HEIGHT, SITTING	X				mm	
8.	FUNCTIONAL LEG LENGTH	X				mm	

MOBILE KITCHEN TRAILER (MKT)

Evaluator: _____ *Subject Number:* _____

TASK I: SETUP TENTAGE [demonstrate task: reach lifting loop with feet flat & grip at center of palm (instruct re: grip as if lifting it); install support pole components: strut, grommet pin, and pole pin; instruct re: potential of strut striking head]; soldier performs task; evaluate ability

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY ~	DID W/ EXTREME DIFFICULTY~	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
REACH LIFTING LOOP ^					1 2 3 4 5 6		
INSTALL STRUT					1 2 3 4 5 6		
INSTALL GROMMET PIN					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

~ DID W/MODERATE DIFFICULTY: on toes but w/arms flexed; did w/extreme difficulty: on toes w/arms@full extension

^ REACH LIFTING LOOP: (note: if subject is on toes, did w/difficulty; determine degree by observing body positioning)

TASK 2: KITCHEN OPERATIONS [demonstrate tasks: remove/replace fire extinguisher range side, install utensil holder range side, hang utensil range side w/no body contact(NBC), raise range cabinet cover full up w/NBC, release cover lock mechanism w/NBC, lower range cabinet w/NBC, open range and remove/replace pot w/NBC; instruct re: removing/replacing pot by grasping the shroud around pot; soldier performs task; evaluate reach

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
REMOVE FIRE EXTINGUISHER					1 2 3 4 5 6		
REPLACE FIRE EXTINGUISHER					1 2 3 4 5 6		
INSTALL UTENSIL HOLDER					1 2 3 4 5 6		
HANG UTENSIL					1 2 3 4 5 6		
RAISE RANGE COVER UP					1 2 3 4 5 6		
RELEASE RANGE COVER LOCK					1 2 3 4 5 6		
LOWER RANGE COVER					1 2 3 4 5 6		
REMOVE POT					1 2 3 4 5 6		
REPLACE POT					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

TASK 3: ADDITIONAL QUESTIONS

1. Did you feel at risk of injury at any time because you could not reach something? YES NO Comment:_____

2. Was there anything you felt you had difficulty performing? YES NO Comment:_____

HEMMT (M978)

Evaluator: _____ *Subject Number:* _____

TASK 1: MOUNT MAINTENANCE PLATFORM & REMOVE/REPLACE PANEL [demonstrate task: climb tire and mount platform; instruct re: removing&replacing panel in whatever fashion that would prevent subject from contacting internal components(i.e. w/1 or 2 arms); instruct re: clearing the air filter w/panel & and front panel coming forward; instruct re: dismount whichever way subject feels safest]; soldier performs task; evaluate ability

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
MOUNT MAINT. PLATFORM					1 2 3 4 5 6		
REMOVE PANEL					1 2 3 4 5 6		
REPLACE PANEL					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

TASK 2: MOUNT CAB AND OPERATE DRIVER CONTROLS [demonstrate task: mount cab, open door, adjust seat belt, adjust seat, depress brake pedal, sight objects(adjust mirrors), reach engine switch, dismount cab; instruct re: adjusting mirrors]; soldier performs task; evaluate ability

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
MOUNT CAB/OPEN DOOR					1 2 3 4 5 6		
BRAKE FULL DOWN					1 2 3 4 5 6		
SIGHT OBJ. AHEAD ~	A B C	A B C	A B C	A B C	1 2 3 4 5 6		
SIGHT OBJ.@15FT REAR-L					1 2 3 4 5 6		
SIGHT OBJ.@15FT REAR-R					1 2 3 4 5 6		
REACH ENGINE SWITCH					1 2 3 4 5 6		
DISMOUNT CAB					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

~SIGHT OBJ. AHEAD: (instruct re: can you sight obj. (a,b,c)? can it be seen w/o diff., w/mod.diff., w/etrm.diff.? repeat for each obj.)

TASK 3: OPERATE FUEL CONTROLS [demonstrate task: reach red pressure valve; crank hose counterclockwise 1 rotation; close rear hatch&lock; release ladder, extend & replace]; soldier performs

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
REACH PRESSURE VALVE					1 2 3 4 5 6		
CRANK HOSE 1 ROTATION					1 2 3 4 5 6		
CLOSE & LOCK REAR HATCH					1 2 3 4 5 6		
RELEASE & REPLACE LADDER					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

TASK 4: ADDITIONAL QUESTIONS

1. Could you safely reach all hand and footholds? YES NO Comment: _____
2. Did you feel at risk of injury at any time because you could not reach something? YES NO Comment: _____
3. Was there anything you felt you had difficulty performing? YES NO Comment: _____

TASK 5: SEAT MEASUREMENTS

MEASUREMENTS TO BE TAKEN:	(in millimetres)
SEAT BASE FORWARD DISTANCE TO FRONT	
SEAT HEIGHT	

M911 HEAVY EQUIPMENT TRANSPORTER

Evaluator: _____ *Subject Number:* _____

TASK 1: MOUNT SIDE MAINTENANCE PLATFORM [demonstrate task: mount to side maintenance platform, open hood to full 2 arm extension, close hood, & dismount platform; instruct re: use of caution when passing side mirror assembly and awareness of edge of platform when closing the hood]; soldier performs task; evaluate ability

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
MOUNT SIDE MAINT. PLAT.					1 2 3 4 5 6		
OPEN HOOD					1 2 3 4 5 6		
CLOSE HOOD					1 2 3 4 5 6		
DISMOUNT PLATFORM					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

TASK 2: OPERATE DRIVER CONTROLS [demonstrate tasks: mount cab, adjust seat belt, adjust seat, depress brake pedal full down, sight objects (adjust mirrors), reach shifter, dismount cab instruct re: adjust mirrors; once in cab, wait until evaluator enters passanger side to evaluate internal tasks (optional)]; subject performs tasks

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
MOUNT CAB					1 2 3 4 5 6		
BRAKE FULL DOWN					1 2 3 4 5 6		
SIGHT OBJ. AHEAD ~	A B C	A B C	A B C	A B C	1 2 3 4 5 6		
SIGHT OBJ.@15FT REAR-L					1 2 3 4 5 6		
SIGHT OBJ.@15FT REAR-R					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

~SIGHT OBJ. AHEAD: (instruct re: can you sight obj. (a,b,c)? can it be seen w/o diff., w/mod.diff., w/etrm.diff.? repeat for each obj.)

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
REACH SHIFTER					1 2 3 4 5 6		
DISMOUNT CAB					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

TASK 3: OPERATE WINCH CONTROLS [demonstrate task: reach and unscrew 1 rotation winch nut; mount to winch platform]; soldier performs task

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
REACH/UNSCREW NUT					1 2 3 4 5 6		
MOUNT WINCH PLATFORM					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

TASK 4: ADDITIONAL QUESTIONS

1. Could you safely reach all hand and footholds? YES NO Comment: _____
2. Did you feel at risk of injury at any time because you could not reach something? YES NO Comment: _____
3. Was there anything you felt you had difficulty performing? YES NO Comment: _____

TASK 5: SEAT MEASUREMENTS

MEASUREMENTS TO BE TAKEN:	(in millimetres)
SEAT BASE FORWARD DISTANCE TO FRONT	
SEAT HEIGHT	

10K ROUGH TERRAIN FORKLIFT

Evaluator: _____ *Subject Number:* _____

TASK 1: ACCESS ENGINE COMPARTMENT [demonstrate task: remove and replace left side panel]; soldier performs task; evaluate ability

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
REMOVE LEFT SIDE PANEL					1 2 3 4 5 6		
REPLACE LEFT SIDE PANEL					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

TASK 2a: MOUNT VEHICLE [mount to maintenance platform; dismount platform]; soldier performs task ; evaluate ability, reach to first step

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
MOUNT MAINT. PLATFORM					1 2 3 4 5 6		
DISMOUNT MAINT. PLATFORM					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

TASK 2b: MOUNT TO INSIDE CAB [demonstrate task : mount to inside cab; instruct re: tasks - adjust seat belt, adjust seat, sighting objects, reaching brake pedal, reach and operation of light switch; dismount cab]; soldier performs task; evaluate ability, reach to first step

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
MOUNT CAB/OPEN DOOR					1 2 3 4 5 6		
LEFT BRAKE FULL DOWN					1 2 3 4 5 6		
SIGHT OBJ.@FORK ENDS ^					1 2 3 4 5 6		
SIGHT OBJ.@15 FT. REAR					1 2 3 4 5 6		
REACH&OPERATE LIGHT SWITCH ~					1 2 3 4 5 6		
DISMOUNT CAB					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

^ SIGHT OBJECT AT FORK ENDS (note: instruct and/or note whether subject sighted object over or through the forklift mechanism)

~ REACH AND OPERATE LIGHT SWITCH (note: instruct re: how to operate light switch - thumb@unlock, forefinger@top switch, while pushing up with thumb, push down with index finger)

TASK 3: ADDITIONAL QUESTIONS

1. Could you safely reach all hand and footholds? YES NO Comment:_____
2. Did you feel at risk of injury at any time because you could not reach something? YES NO Comment:_____
3. Was there anything you felt you had difficulty performing? YES NO Comment:_____

TASK 4: SEAT MEASUREMENTS

MEASUREMENTS TO BE TAKEN:	(in millimetres)
SEAT BASE FORWARD DISTANCE TO FRONT	
SEAT HEIGHT	

ARMORED TRACKED CARRIER (M577, MII3, MI064, MI25, MI059, MI06)

Evaluator: _____ *Subject Number:* _____

TASK I: ACCESS DRIVER'S HATCH [demonstrate task: climb to driver's hatch (instruct re: not standing on screen); enter hatch (instruct re: waiting until evaluator can observe from outside); soldier performs task; evaluate ability

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
CLIMB TO DRIVER'S HATCH					1 2 3 4 5 6		
ENTER HATCH					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

TASK 2: OPERATE DRIVER CONTROLS FROM A LOWERED SEAT POSITION [demonstrate/inform tasks: adjust seat down, sight object through periscope window w/o obstruction and w/o head backward tilt, reach lower accelerator, reach lower brake pedal, close hatch; inform re: location of hatch release lever and give soldier helmet]; soldier performs task

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
ADJUST SEAT DOWN					1 2 3 4 5 6		
SIGHT OBJ. AHEAD ~	A B C	A B C	A B C	A B C	1 2 3 4 5 6		
REACH LOW. ACCELERATOR					1 2 3 4 5 6		
REACH LOWER BRAKE					1 2 3 4 5 6		
CLOSE HATCH					1 2 3 4 5 6		
HELMET CLEARANCE ^		XXXXXXXXXXX	XXXXXXXXXXX		1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

^ HELMET CLEARANCE: (note: either the top of helmet does not hit the hatch (did w/o difficulty) or top of helmet hits the hatch (could not do))

~SIGHT OBJ. AHEAD: (instruct re: can you sight obj. (a,b,c)? can it be seen w/o diff., w/mod.diff., w/etrm.diff.? repeat for each obj.)

TASK 3: OPERATE DRIVER CONTROLS FROM A RAISED SEAT POSITION [demonstrate/inform tasks: open hatch, adjust seat up, sight object, reach upper accelerator, reach upper brake, lower seat and exit through back of vehicle; inform re: once hatch open, remove helmet; wait until evaluator is outside in order to evaluate head tilt when sighting object; wait until evaluator has returned inside to evaluate internal tasks]; soldier performs task

TASKS	DID W/O DIFFICULTY	DID W/ MODERATE DIFFICULTY	DID W/ EXTREME DIFFICULTY	COULD NOT DO	DIFFICULTY DUE TO*	COM-MENT?	DESCRIPTION
CODE	1	2	3	4	1-6	1	(text)
OPEN HATCH					1 2 3 4 5 6		
ADJUST SEAT UP					1 2 3 4 5 6		
SIGHT OBJ. AHEAD ~	A B C	A B C	A B C	A B C	1 2 3 4 5 6		
HEAD LEVEL SIGHTING OBJ. ^		XXXXXXXXXXXX	XXXXXXXXXXXX		1 2 3 4 5 6		
REACH UP. ACCELERATOR					1 2 3 4 5 6		
REACH LOWER ACCELERATOR					1 2 3 4 5 6		

* DIFFICULTY CODES: 1=STRENGTH 2=ARMLENGTH 3=LEGLENGTH 4=GRIP 5=STATURE 6=SITTING HEIGHT

^ HEAD LEVEL SIGHTING OBJ. (note: when viewing subject's head level, if head is level or angled down, did w/o difficulty; if head angled up, could not do)

~SIGHT OBJ. AHEAD: (instruct re: can you sight obj. (a,b,c)? can it be seen w/o diff., w/mod.diff., w/etrm.diff.? repeat for each obj.)

TASK 4: ADDITIONAL QUESTIONS

1. Could you safely reach all hand and footholds? YES NO Comment: _____
2. Did you feel at risk of injury at any time because you could not reach something? YES NO Comment: _____
3. Was there anything you felt you had difficulty performing? YES NO Comment: _____

TASK 5: SEAT MEASUREMENTS

MEASUREMENTS TO BE TAKEN:	(in millimetres)
SEAT BASE FORWARD DISTANCE TO FRONT	
SEAT HEIGHT	

Measurer: _____ *Subject Number:* _____

CLOTHING MEASUREMENTS

INTRAOBSERVER ERROR: *N/A* *AM* *PM*

MEASUREMENT						COMMENT:
1) Weight			•		Kg	
2) Stature					mm	
3) Crotch Height					mm	
4) Chest Circumference					mm	
5) Waist Circumference, NI					mm	
6) Head Circumference					mm	
7) Head Breadth					mm	
8) Head Length					mm	
9) Hand Length					mm	
10) Hand Circumference					mm	

Evaluator: _____ *Subject Number:* _____

COLD WEATHER TRIGGER FINGER MITTENS

1. **FIT:** PREDICTED SIZE: _____ Reason for rejection: [1]short [2]long [3]loose [4]tight
   BEST FIT SIZE: _____

2. **STATIC FIT ASSESSMENT** (If any 1 * or 2+ are applicable, the BEST FIT SIZE is unacceptable)

a. *In a "V" mitten thumb, index, and crotch are not seated against "V"	THB IDX CTH N/A
b. **Mitten thumb** extends beyond thumbtip >3/8"	YES NO
c. **Mitten hand** extends beyond hand >5/8"	YES NO
d. Mitten **constricts** hand or fingers in circumference	HANDS FING N/A
e. *Excess circumference of glove for entire hand >1-5/8"	YES NO

3. **Do the CW Trigger Finger Mittens hinder the performance of the following movements?** (If any 1 * OR 2+ are applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
DONNING	Y N	
MAKING A FIST	Y N	
*TRIGGER	Y N	
WRIST FLEXION	Y N	
DOFFING	Y N	

4. ***"How would you describe the fit of the CW Trigger Finger Mittens?"***

A: Functional ☐
Non-functional ☐

B: Comfortable ☐
Neither ☐
Uncomfortable ☐

5. **Assess the fit of the BEST FIT SIZE:** 1) UNACCEPTABLE 2) ACCEPTABLE

6. ***"Are you currently issued this item?"*** YES NO [If Yes, Continue]

7. ***"What is the size issued to you?"*** _____

8. ***"Have you modified this item to fit you better?"*** YES NO

If YES, describe: _____

Evaluator: _____ *Subject Number:* _____

CVC COVERALLS (UNDERGARMENTS)

1. **FIT:** PREDICTED SIZE: _____ Reason for rejection: [1]short [2]long [3]loose [4]tight
   BEST FIT SIZE: _____

2. STATIC FIT ASSESSMENT (If any 4+ are applicable, the BEST FIT SIZE is unacceptable)

a. Does the **waist band** fall above/below natural waist by >1"?	ABOVE	BELOW	N/A
b. Do **sleeve cuffs** fall below knuckle line or above wrist?	ABOVE	BELOW	N/A
c. Is the fabric too tight/loose over the **bust**?	TIGHT	LOOSE	N/A
d. Is the fabric too tight/loose over the **back**?	TIGHT	LOOSE	N/A
e. Is the fabric too tight/loose over the **buttocks**?	TIGHT	LOOSE	N/A
f. Is the fabric too tight/loose over the **abdomen**?	TIGHT	LOOSE	N/A
g. Is the fabric too tight/loose over the **waist**?	TIGHT	LOOSE	N/A
h. Do **knee pleats** fall above/below knee by more than 2"?	ABOVE	BELOW	N/A
i. Is there more than 2" or less than 1" of fabric **between garment crotch and crotch of the subject**?	MORE	LESS	N/A
j. Do the **coverall leg hems** contact the floor?	YES		NO
k. Does the **shoulder seam** extend more than 1" into deltoid area?	YES		NO
l. Does the **front opening** at neck expose 2" below suprasternale?	YES		NO
m. Are the **bottoms of the hip pockets** reached by dropping shoulders?	YES		NO
n. Is it difficult to put a **balled fist** into the hip pockets?	YES		NO

3. Do the CVC Coveralls hinder the performance of the following movements?

(If any 1 * OR 3+ are applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
DONNING	Y N	
*MARCH IN PLACE	Y N	
SQUATTING	Y N	
BEND AT WAIST	Y N	
TURN HEAD	Y N	
REACH FRONT	Y N	
REACH SIDE	Y N	
*REACH UP	Y N	
*CLIMBING	Y N	
DOFFING	Y N	

4. ***"How would you describe the fit of the CVC Coveralls?"***

A: Functional ☐
Non-functional ☐

B: Comfortable ☐
Neither ☐
Uncomfortable ☐

5. **Assess the fit of the BEST FIT SIZE:** 1) UNACCEPTABLE 2) ACCEPTABLE
   Assess the GENERAL COMPATIBILITY of the *CVC Coveralls* with items worn underneath:
   1) UNACCEPTABLE 2) ACCEPTABLE

   INCOMPATIBLE ITEMS: _____

6. ***"Are you currently issued this item?"*** YES NO [If Yes, Continue]

7. ***"What is the size issued to you?"*** _____

8. ***"Have you modified this item to fit you better?"*** YES NO

   If YES, describe: _____

Evaluator: _____ *Subject Number:* _____

MECHANIC'S COVERALLS (UNDERGARMENTS)

1. **FIT:** PREDICTED SIZE: _____ Reason for rejection: [1]short [2]long [3]loose [4]tight
   BEST FIT SIZE: _____

2. STATIC FIT ASSESSMENT (If any 4+ are applicable, the BEST FIT SIZE is unacceptable)

a. Does the **waist band** fall above/below natural waist by >1"?	ABOVE	BELOW	N/A
b. Do **sleeve cuffs** fall below knuckle line or above wrist?	ABOVE	BELOW	N/A
c. Is the fabric too tight/loose over the **bust**?	TIGHT	LOOSE	N/A
d. Is the fabric too tight/loose over the **back**?	TIGHT	LOOSE	N/A
e. Is the fabric too tight/loose over the **buttocks**?	TIGHT	LOOSE	N/A
f. Is the fabric too tight/loose over the **abdomen**?	TIGHT	LOOSE	N/A
g. Is the fabric too tight/loose over the **waist**?	TIGHT	LOOSE	N/A
h. Do **knee pleats** fall above/below knee by more than 2"?	ABOVE	BELOW	N/A
i. Is there more than 2" or less than 1" of fabric **between garment crotch and crotch of the subject**?	MORE	LESS	N/A
j. Do the **coverall leg hems** contact the floor?	YES		NO
k. Does the **shoulder seam** extend more than 1" into deltoid area?	YES		NO
l. Does the **front opening** at neck expose 2" below suprasternale?	YES		NO
m. Are the **bottoms of the hip pockets** reached by dropping shoulders?	YES		NO
n. Is it difficult to put a **balled fist** into the hip pockets?	YES		NO

3. Do the Mechanic's Coveralls hinder the performance of the following movements?

(If any 1 * OR 3+ are applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
DONNING	Y N	
*MARCH IN PLACE	Y N	
SQUATTING	Y N	
BEND AT WAIST	Y N	
TURN HEAD	Y N	
REACH FRONT	Y N	
REACH SIDE	Y N	
*REACH UP	Y N	
*CLIMBING	Y N	
DOFFING	Y N	

4. ***"How would you describe the fit of the Mechanic's Coveralls?"***

A: Functional ☐
Non-functional ☐

B: Comfortable ☐
Neither ☐
Uncomfortable ☐

5. **Assess the fit of the BEST FIT SIZE:** 1) UNACCEPTABLE 2) ACCEPTABLE
   Assess the GENERAL COMPATIBILITY of the *Mechanic's Coveralls* with items worn underneath:
   1) UNACCEPTABLE 2) ACCEPTABLE

   INCOMPATIBLE ITEMS: _____

6. ***"Are you currently issued this item?"*** YES NO [If Yes, Continue]

7. ***"What is the size issued to you?"*** _____

8. ***"Have you modified this item to fit you better?"*** YES NO

   If YES, describe: _____

Evaluator: _____ *Subject Number:* _____

A.L.I.C.E. LARGE PACK WITH FRAME (BDU, PASGT, LBV)

1. STATIC FIT ASSESSMENT (If any 1 * or 3+ are applicable, then BEST FIT SIZE is unacceptable)

a.* Does frame contact back of the head?	YES		NO
b. Does **waist belt** fall above lower edge of PASGT?	YES		NO
c. Is **waist strap** >1" above or below waist line?	ABOVE	BELOW	N/A
d. Can **frame** be moved more than 1" vertically or horizontally?	VERTI	HORIZ	N/A
e. Does **lumbar pad** fall >1" above or below lower back?	ABOVE	BELOW	N/A
f.* Does pack extend over buttocks/hip joint?	YES		NO
g. Do arms **contact frame** when reaching behind?	YES		NO

2. Does the A.L.I.C.E. hinder the performance of the following movements?

(If any 1 * or 3+ are applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
DONNING	Y N	
*MARCH IN PLACE	Y N	
SQUATTING	Y N	
BEND AT WAIST	Y N	
TURN HEAD	Y N	
*REACH FRONT	Y N	
REACH SIDE	Y N	
REACH UP	Y N	
CLIMBING	Y N	
DOFFING	Y N	

3. *"How would you describe the fit of the A.L.I.C.E.?"*

A: Functional ☐
Non-functional ☐

B: Comfortable ☐
Neither ☐
Uncomfortable ☐

4. Assess the fit of the BEST FIT SIZE: 1) UNACCEPTABLE 2) ACCEPTABLE

Assess the GENERAL COMPATIBILITY of the *A.L.I.C.E.* with items worn underneath:

1) UNACCEPTABLE 2) ACCEPTABLE

INCOMPATIBLE ITEMS: _____

5. *"Are you currently issued this item?"* YES NO [If Yes, Continue]
6. *"What is the size issued to you?"* _____
7. *"Have you modified this item to fit you better?"* YES NO

   If YES, describe: _____

PASGT VEST (BDU) *Evaluator:* _____ *Subject Number:* _____

☐ MEASURED ☐ SELF-REPORTED

1. **FIT:** PREDICTED SIZE: _____ Reason for rejection: 1short 2long 3loose 4tight
   BEST FIT SIZE: _____

2. **STATIC FIT ASSESSMENT** (If any 1 * or 3+ are applicable, then BEST FIT SIZE is unacceptable)

a. *Viewed from front do **armholes** expose >1" chest area when arms are at sides?	YES		NO
b. Does length extend below or rest above **waist band** of BDU?	ABOVE	BELOW	N/A
c. Can **vest be moved** more than 2" vertically or horizontally?	VERTI	HORIZ	N/A
d. *Is **chest compressed** to the point that vest cannot shift at all?	YES		NO
e. Does **collar** overlap jawline or chin?	JAW	CHIN	N/A
f. Do **shoulder pads** extend more than 1" beyond shoulder ball?	YES		NO

3. **Does the PASGT vest hinder the performance of any of the following movements?**
   (If any 1 * or 3+ are applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
DONNING	Y N	
*MARCH IN PLACE	Y N	
SQUATTING	Y N	
BEND AT WAIST	Y N	
TURN HEAD	Y N	
*REACH FRONT	Y N	
REACH SIDE	Y N	
REACH UP	Y N	
CLIMBING	Y N	
DOFFING	Y N	

4. ***"How would you describe the fit of the PASGT vest?"***

   A: Functional ☐
   Non-functional ☐

   B: Comfortable ☐
   Neither ☐
   Uncomfortable ☐

5. **Assess the fit of the BEST FIT SIZE:** 1) UNACCEPTABLE 2) ACCEPTABLE
6. ***"Are you currently issued this item?"*** YES NO [If Yes, Continue]
7. ***"What is the size issued to you?"*** _____
8. ***"Have you modified this item to fit you better?"*** YES NO

   If YES, describe: _____

Evaluator: _____ *Subject Number:* _____

TACTICAL LOAD BEARING VEST (BDU, PASGT)

1. STATIC FIT ASSESSMENT (If any 1 * or 3+ are applicable, then BEST FIT SIZE is unacceptable)

a. Is **chest strap** at or below bust?	AT	BELOW	N/A
b. Does **waist belt** fall above lower edge of PASGT?	YES		NO
c. Is the **waist belt** more than 1" away from the waist line?	ABOVE	BELOW	N/A
d. Can **vest be moved** more than 2" vertically or horizontally?	VERTI	HORIZ	N/A
e. Can **waist belt** not accommodate 2 canteens and shovel?	YES		NO
f. Do **shoulder pads** extend over the shoulder ball?	YES		NO

2. Does the LBV hinder the performance of the following movements?

(If any 1 * or 3+ are applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
DONNING	Y N	
*MARCH IN PLACE	Y N	
SQUATTING	Y N	
BEND AT WAIST	Y N	
TURN HEAD	Y N	
*REACH FRONT	Y N	
REACH SIDE	Y N	
REACH UP	Y N	
CLIMBING	Y N	
DOFFING	Y N	

3. *"How would you describe the fit of the LBV?"*

A: Functional ☐
Non-functional ☐

B: Comfortable ☐
Neither ☐
Uncomfortable ☐

4. Assess the fit of the BEST FIT SIZE: 1) UNACCEPTABLE 2) ACCEPTABLE

Assess the GENERAL COMPATIBILITY of the *LBV* with items worn underneath:

1) UNACCEPTABLE 2) ACCEPTABLE

INCOMPATIBLE ITEMS: _____

5. *"Are you currently issued this item?"* YES NO [If Yes, Continue]
6. *"What is the size issued to you?"* _____
7. *"Have you modified this item to fit you better?"* YES NO

If YES, describe: _____

Evaluator: _____ *Subject Number:* _____

COLD WEATHER PARKA (POLYPRO, FIBERPILE)

1. **FIT:** PREDICTED SIZE: _____ Reason for rejection: [1]short [2]long [3]loose [4]tight
   BEST FIT SIZE: _____

2. STATIC FIT ASSESSMENT (If any 1 * or 4+ are applicable, the BEST FIT SIZE is unacceptable)

a. Does the **waist band** fall above/below natural waist by >1"?	ABOVE	BELOW	N/A
b. Do **sleeve cuffs** fall below knuckle line or above wrist?	ABOVE	BELOW	N/A
c. Is the fabric too tight/loose over the **bust**? *(gaping buttons)*	TIGHT	LOOSE	N/A
d. Is the fabric too tight/loose over the **back**?	TIGHT	LOOSE	N/A
e. Is the fabric too tight/loose over the **buttocks**?	TIGHT	LOOSE	N/A
f. Is the fabric too tight/loose over the **abdomen**? *(protuding hem)*	TIGHT	LOOSE	N/A
g. Is the fabric too tight/loose over the **waist**?	TIGHT	LOOSE	N/A
h. Is the elasticized **waist baffle** too loose/tight?	TIGHT	LOOSE	N/A
i. Does the **hood visor** block forward vision?	YES		NO
j. *When bending forward, does the garment **gape at the neck**?	YES		NO
k. Is the **bottom of the front pockets** reached with dropping shoulders?	YES		NO
l. Does the **hem of the parka** not extend to crotch level?	YES		NO
m. Is it difficult to put a **balled fist** into front pockets?	YES		NO

3. Does the CW Parka hinder the performance of the following movements?

(If any 1 * OR 3+ are applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
DONNING	Y N	
*MARCH IN PLACE	Y N	
SQUATTING	Y N	
BEND AT WAIST	Y N	
TURN HEAD	Y N	
*REACH FRONT	Y N	
REACH SIDE	Y N	
REACH UP	Y N	
CLIMBING	Y N	
DOFFING	Y N	

4. *"How would you describe the fit of the CW Parka?"*

A: Functional ☐
Non-functional ☐

B: Comfortable ☐
Neither ☐
Uncomfortable ☐

5. **Assess the fit of the BEST FIT SIZE:** 1) UNACCEPTABLE 2) ACCEPTABLE
Assess the GENERAL COMPATIBILITY of the *CW Parka* with items worn underneath:
1) UNACCEPTABLE 2) ACCEPTABLE

INCOMPATIBLE ITEMS: _____

6. ***"Are you currently issued this item?"*** YES NO [If Yes, Continue]

7. ***"What is the size issued to you?"*** _____

8. ***"Have you modified this item to fit you better?"*** YES NO

If YES, describe: _____

WET WEATHER TROUSERS *Evaluator:* _____ *Subject Number:* _____

1. **FIT:** PREDICTED SIZE: _____ Reason for rejection: [1]short [2]long [3]loose [4]tight
   BEST FIT SIZE: _____

2. **STATIC FIT ASSESSMENT** (If any 3+ are applicable, the BEST FIT SIZE is unacceptable)

a. Is the fabric too tight/loose over **buttocks**?	TIGHT	LOOSE	N/A
b. Is the fabric too tight/loose over **abdomen**?	TIGHT	LOOSE	N/A
c. Is the fabric too tight/loose over **waist**?	TIGHT	LOOSE	N/A
d. Is there more than 2" or less than 1" of fabric **between the garment crotch and subject's crotch**?	MORE	LESS	N/A
e. Do **trouser leg hems** contact the floor?	YES		NO
f. Is the **waist string** too short that it can't be ties at the waist?	YES		NO

3. **Do the WW Trousers hinder the performance of the following movements?**
   (If any 1 * OR 2+ are applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
DONNING	Y N	
MARCH IN PEACE	Y N	
SQUATTING	Y N	
CLIMBING	Y N	
DOFFING	Y N	

4. ***"How would you describe the fit of the WW Trousers?"***

   A: Functional ☐
   Non-functional ☐

   B: Comfortable ☐
   Neither ☐
   Uncomfortable ☐

5. **Assess the fit of the BEST FIT SIZE:** 1) UNACCEPTABLE 2) ACCEPTABLE

6. ***"Are you currently issued this item?"*** YES NO [If Yes, Continue]
7. ***"What is the size issued to you?"*** _____
8. ***"Have you modified this item to fit you better?"*** YES NO

   If YES, describe: _____

Evaluator: _____ *Subject Number:* _____

LIGHT DUTY WORK GLOVES

1. **FIT:** PREDICTED SIZE: _____ Reason for rejection: [1]short [2]long [3]loose [4]tight
   BEST FIT SIZE: _____

2. **STATIC FIT ASSESSMENT** (If any 1 * or 2+ are applicable, the BEST FIT SIZE is unacceptable)

a. *In a "V", glove thumb, index, and crotch are not seated against "V"	THB IDX CTH	N/A
b. **Thumb, index, ring, middle fingers** of glove extend beyond fingertip >3/8"	T I R MF	N/A
c. **Little finger** of glove extends beyond little finger >5/8"	YES	NO
d. Glove finger **crotches offset** from finger crotches >3/8"	YES	NO
e. Glove constricts hand or fingers in **circumference**	YES	NO
f. **Excess circumference of fingers** exceeds that of any one finger >1/2"	YES	NO
g. *Excess circumference of glove for entire hand >1-5/8"	YES	NO

3. **Do the Light Duty Work Gloves hinder the performance of the following movements?** (If any 1 * OR 2+ are applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
DONNING	Y N	
MAKING A FIST	Y N	
*TRIGGER	Y N	
WRIST FLEXION	Y N	
DOFFING	Y N	

4. *"How would you describe the fit of the Light Duty Work Gloves?"*

A:		B:	
Functional	☐	Comfortable	☐
Non-functional	☐	Neither	☐
		Uncomfortable	☐

5. **Assess the fit of the BEST FIT SIZE:** 1) UNACCEPTABLE 2) ACCEPTABLE

6. ***"Are you currently issued this item?"*** YES NO [If Yes, Continue]

7. ***"What is the size issued to you?"*** _____

8. ***"Have you modified this item to fit you better?"*** YES NO

   If YES, describe: _____

PASGT HELMET *Evaluator:* _____ *Subject Number:* _____

1. **FIT:** PREDICTED SIZE: _____ Reason for rejection: 1short 2long 3loose 4tight
   BEST FIT SIZE: _____

2. **STATIC FIT ASSESSMENT** (If any 1 * is applicable, the BEST FIT SIZE is unacceptable)

a. Is the leading edge of helmet over eyeline?	YES	NO
b. Will the chin strap not cinch down?	YES	NO
c. Is the occipital edge of the helmet below the neckline?	YES	NO
d. Is the helmet able to shift on head more than [illegible]	YES	NO

3. **"Does the PASGT helmet hinder the performance of the following movements?**
   (If any 1 * is applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
TURNING HEAD TO SIDE	Y N	
TILTING HEAD BACK	Y N	
TILTING HEAD DOWN	Y N	
FORWARD VISION	Y N	

4. ***"How would you describe the fit of the PASGT helmet?"***

A:		B:	
Functional	☐	Comfortable	☐
Non-functional	☐	Neither	☐
		Uncomfortable	☐

5. **Assess the fit of the BEST FIT SIZE:** 1) UNACCEPTABLE 2) ACCEPTABLE

6. ***"Are you currently issued this item?"*** YES NO [If Yes, Continue]
7. ***"What is the size issued to you?"*** _____
8. ***"Have you modified this item to fit you better?"*** YES NO

   If YES, describe: _____

PARACHUTE HARNESS (BDU) *Evaluator:* _____ *Subject Number:* _____

1. **FIT:** PREDICTED SIZE: _____ Reason for rejection: 1short 2long 3loose 4tight
   BEST FIT SIZE: _____

2. **STATIC FIT ASSESSMENT** (If any 1 * or 2+ are applicable, the BEST FIT SIZE is unacceptable)

a. Does the **top of the pack** extend above the shoulder line?	YES		NO
b. Can harness be moved more than 1" vertically or horizontally?	VERTI	HORIZ	N/A
c. Do shoulder buckles fall more than 1" below bent chin? *(should be in hollow of shoulder)*	YES		NO
d. Does **pack** extend below buttocks/hip joint?	YES		NO
e. Does **saddle** ride above buttocks or below at tights?	ABOVE	BELOW	N/A
f. Does the **chest strap** fall below bust level?	ABOVE	BELOW	N/A

3. **Does the parachute harness hinder the performance of the following movements?**
   (If any 1 * OR 3+ are applicable, then BEST FIT SIZE is unacceptable)

ACTIVITY		*COMMENT:*
DONNING	Y N	
*MARCH IN PLACE	Y N	
SQUATTING	Y N	
BEND AT WAIST	Y N	
TURN HEAD	Y N	
REACH FRONT	Y N	
REACH SIDE	Y N	
*REACH UP	Y N	
CLIMBING	Y N	
DOFFING	Y N	

4. ***"How would you describe the fit of the parachute harness?"***

   A: Functional ☐
   Non-functional ☐

   B: Comfortable ☐
   Neither ☐
   Uncomfortable ☐

5. **Assess the fit of the BEST FIT SIZE:** 1) UNACCEPTABLE 2) ACCEPTABLE
   Assess the GENERAL COMPATIBILITY of the *parachute harness* with items worn underneath: 1) UNACCEPTABLE 2) ACCEPTABLE
   INCOMPATIBLE ITEMS: _____

6. ***"Are you currently issued this item?"*** YES NO [If Yes, Continue]
7. ***"What is the size issued to you?"*** _____
8. ***"Have you modified this item to fit you better?"*** YES NO

   If YES, describe: _____

APPENDIX D
Development of the Critiria for Determining Problematic Items

DEVELOPMENT OF THE CRITERIA FOR DETERMINING PROBLEMATIC ITEMS

U.S. Army requirements documents for development of workstations, clothing, and individual equipment typically specify the anthropometric accommodation required as the 5th percentile though the 95th percentile values for a given body dimension. Thus, all potential users of an item who fall within the 5th-95th percentile range for the particular body dimension are to be adequately fit or accommodated. An outcome of this design approach is that 10% of the population will, in theory, be disaccommodated. It is most often assumed that the 10% who are disaccommodated fall at the upper and the lower tails of the distribution for the relevant body dimension. However, fit and accommodation are rarely defined on the basis of a single anthropometric dimension, so the actual accommodation range for a particular item is difficult to predict. Furthermore, the range of required accommodation has traditionally been based on the body dimension distributions of male soldiers. The present study involved determining which workstations and other items under test here are likely to be problematic for use by Army females, as opposed to males. In addition, the determinations had to be based on data from a sample of female soldiers 5'5" and under in stature. Thus, an approach was needed for applying the 5th-95th percentile range of design accommodation to the data of the study.

Since the test sample was comprised, by definition, of females who fell at or below the 5th percentile male value for stature (5'5"), the study females were, a priori, theoretically disaccommodated in the workstations, clothing items, and equipment items included in the study. Therefore, the issue was not one of disaccommodation outside the 5th-95th percentile design envelope. The issue was one, rather, of relating the proportion of the study sample disaccommodated to the generally accepted 10% disaccommodated in the population. To address the issue, a critical threshold point was defined. It is the proportion of the study sample that must be disaccommodated in order to declare that the workstation or other items being tested are problematic for use by the Army female population.

A number of candidate critical threshold points were derived using different anthropometric distributions of the Army population (i.e., males and females separate, males and females combined). The final critical threshold point used in the study was based upon these calculations, past experience with anthropometric fit assessment studies in which subjects were not randomly selected, and the goal of minimizing Type I errors. The critical threshold point was set at 15% of the study sample. That is, if 15% of the study sample was disaccommodated, the item was declared to be problematic for the Army female population. This portion equals the 10% disaccommodation rate typically imposed in development of Army items plus 5% to allow for the relative imprecision of the qualitative assessment methods used in this study.

APPENDIX E
Frequencies for Acceptability and Unacceptability of All Workstation Tasks

	EXTR DIFF. COULD NOT DO		NO OR MOD DIFF		MISSING		Total	
	Count	%	Count	%	Count	%	Count	%
LOWER RANGE COVER	58.8	28.7%	141.8	69.2%	4.4	2.2%	205.0	100.0%
REMOVE POT	.0	.0%	200.6	100.0%	.0	.0%	200.6	100.0%
REPLACE POT	.0	.0%	200.6	100.0%	.0	.0%	200.6	100.0%
REACH LIFTING LOOP	26.9	13.4%	173.7	86.6%	.0	.0%	200.6	100.0%
INSTALL STRUT	.0	.0%	200.6	100.0%	.0	.0%	200.6	100.0%
INSTALL GROMMET PIN	.3	.2%	200.3	99.8%	.0	.0%	200.6	100.0%
REMOVE FIRE EXTINGUISHER	89.1	43.5%	111.5	54.4%	4.4	2.2%	205.0	100.0%
REPLACE FIRE EXTINGUISHER	103.0	50.3%	96.6	47.1%	5.4	2.6%	205.0	100.0%
INSTALL UTENSIL HOLDER	118.9	58.0%	41.9	20.4%	44.2	21.6%	205.0	100.0%
HANG UTENSIL	5.9	3.7%	154.9	96.3%	.0	.0%	160.8	100.0%
RAISE RANGE COVER UP	40.2	19.6%	160.4	78.2%	4.4	2.2%	205.0	100.0%
RELEASE RANGE COVER PROP	60.0	29.3%	140.6	68.6%	4.4	2.2%	205.0	100.0%

M978 HEMTT FUEL TANKER

	EXTR DIFF. COULD NOT DO		NO OR MOD DIFF		MISSING		Total	
	Count	%	Count	%	Count	%	Count	%
MOUNT MAINTENANCE PLATFORM	1.1	.6%	183.9	99.4%	.0	.0%	185.0	100.0%
LIFT ENGINE PANEL	22.1	12.0%	162.9	88.0%	.0	.0%	185.0	100.0%
REPLACE ENGINE PANEL	29.3	14.3%	155.7	76.0%	20.0	9.8%	205.0	100.0%
MOUNT CAB	2.1	1.1%	192.9	98.9%	.0	.0%	195.0	100.0%
PRESS BRAKE FULL DOWN	.0	.0%	195.0	100.0%	.0	.0%	195.0	100.0%
SIGHT OBJ A AHEAD	.0	.0%	195.0	100.0%	.0	.0%	195.0	100.0%
SIGHT OBJ B AHEAD	.0	.0%	194.0	100.0%	.0	.0%	194.0	100.0%
SIGHT OBJ C AHEAD	.0	.0%	193.6	100.0%	.0	.0%	193.6	100.0%
SIGHT OBJ@15FT REAR-L	.0	.0%	192.8	100.0%	.0	.0%	192.8	100.0%
SIGHT OBJ@15FT REAR-R	.0	.0%	191.7	100.0%	.0	.0%	191.7	100.0%
REACH ENGINE SWITCH	.0	.0%	194.6	100.0%	.0	.0%	194.6	100.0%
DISMOUNT CAB	.3	.2%	186.7	99.8%	.0	.0%	187.0	100.0%
REACH PRESSURE VALVE	13.3	6.8%	181.9	93.2%	.0	.0%	195.2	100.0%
CRANK HOSE ONE ROTATION	1.4	.9%	154.9	99.1%	.0	.0%	156.2	100.0%
CLOSE AND LOCK REAR HATCH	35.8	17.4%	159.4	77.8%	9.8	4.8%	205.0	100.0%
REACH V8 VALVE	92.7	45.2%	48.5	23.7%	63.8	31.1%	205.0	100.0%
REACH V7 VALVE	129.8	63.3%	11.4	5.6%	63.8	31.1%	205.0	100.0%

	EXTR DIFF. COULD NOT DO		NO OR MOD DIFF		MISSING		Total	
	Count	%	Count	%	Count	%	Count	%
REACH SHIFTER	.0	.0%	180.5	100.0%	.0	.0%	180.5	100.0%
DISMOUNT CAB	.0	.0%	180.5	100.0%	.0	.0%	180.5	100.0%
MOUNT WINCH PLATFORM	.0	.0%	182.7	100.0%	.0	.0%	182.7	100.0%
DISMOUNT WINCH PLATFORM	.0	.0%	182.7	100.0%	.0	.0%	182.7	100.0%
UNLATCH HOOD	4.3	2.4%	175.1	97.6%	.0	.0%	179.5	100.0%
OPEN HOOD	30.1	14.7%	149.4	72.9%	25.5	12.5%	205.0	100.0%
CLOSE HOOD	129.3	63.1%	50.2	24.5%	25.5	12.5%	205.0	100.0%
LATCH HOOD	5.8	3.4%	168.3	96.6%	.0	.0%	174.1	100.0%
MOUNT CAB	.0	.0%	182.4	100.0%	.0	.0%	182.4	100.0%
PRESS BRAKE FULL DOWN	3.4	1.9%	179.3	98.1%	.0	.0%	182.7	100.0%
SIGHT OBJ A AHEAD	13.6	7.4%	169.1	92.6%	.0	.0%	182.7	100.0%
SIGHT OBJ B AHEAD	.0	.0%	182.7	100.0%	.0	.0%	182.7	100.0%
SIGHT OBJ C AHEAD	.0	.0%	182.7	100.0%	.0	.0%	182.7	100.0%
SIGHT OBJ 15FT REAR-L	.0	.0%	182.7	100.0%	.0	.0%	182.7	100.0%
SIGHT OBJ 15FT REAR-R	.0	.0%	181.5	100.0%	.0	.0%	181.5	100.0%

M10A ROUGH TERRAIN FORKLIFT

	EXTR DIFF. COULD NOT DO		NO OR MOD DIFF		MISSING		Total	
	Count	%	Count	%	Count	%	Count	%
DISMOUNT CAB	.0	.0%	158.2	100.0%	.0	.0%	158.2	100.0%
REMOVE ENGINE PANEL	14.8	7.6%	180.0	92.4%	.0	.0%	194.7	100.0%
REPLACE ENGINE PANEL	14.9	7.7%	179.8	92.3%	.0	.0%	194.7	100.0%
MOUNT MAINTENANCE PLATFORM	.0	.0%	201.5	100.0%	.0	.0%	201.5	100.0%
DISMOUNT MAINTENANCE PLATFORM	.0	.0%	201.5	100.0%	.0	.0%	201.5	100.0%
MOUNT CAB	.0	.0%	201.5	100.0%	.0	.0%	201.5	100.0%
PRESS BRAKE FULL DOWN	16.8	8.3%	184.7	91.7%	.0	.0%	201.5	100.0%
SIGHT OBJ@FORK END	32.5	15.9%	169.0	82.4%	3.5	1.7%	205.0	100.0%
SIGHT OBJECT AT 15FT REAR	54.4	26.5%	145.2	70.8%	5.5	2.7%	205.0	100.0%
REACH AND OPERATE LIGHT SWITCH	1.1	.5%	200.4	99.5%	.0	.0%	201.5	100.0%

M577A2 LIGHT TRACKED COMMAND POST CARRIER

	EXTR DIFF. COULD NOT DO		NO OR MOD DIFF		MISSING		Total	
	Count	%	Count	%	Count	%	Count	%
ADJUST SEAT UP	.0	.0%	202.7	100.0%	.0	.0%	202.7	100.0%
SIGHT OBJECT A SEAT UP	1.5	.8%	195.5	99.2%	.0	.0%	197.0	100.0%
SIGHT OBJECT B SEAT UP	.0	.0%	200.4	100.0%	.0	.0%	200.4	100.0%
SIGHT OBJECT C SEAT UP	1.1	.5%	194.8	99.5%	.0	.0%	195.9	100.0%
VISION OUT OF DRIVER'S HATCH SEAT UP	31.0	15.1%	157.8	77.0%	16.2	7.9%	205.0	100.0%
REACH UPPER ACCELERATOR	26.7	13.2%	176.0	86.8%	.0	.0%	202.7	100.0%
CLIMB TO HATCH	2.1	1.1%	194.3	98.9%	.0	.0%	196.5	100.0%
ENTER HATCH	1.1	.6%	193.1	99.4%	.0	.0%	194.2	100.0%
ADJUST SEAT DOWN	.0	.0%	201.5	100.0%	.0	.0%	201.5	100.0%
SIGHT OBJ A SEAT DOWN	15.9	11.6%	121.1	88.4%	.0	.0%	137.0	100.0%
SIGHT OBJ B SEAT DOWN	2.6	1.3%	196.4	98.7%	.0	.0%	198.9	100.0%
SIGHT OBJ C SEAT DOWN	1.2	.7%	164.1	99.3%	.0	.0%	165.3	100.0%
REACH LOWER ACCELERATOR	.4	.2%	200.5	99.8%	.0	.0%	200.9	100.0%
CVC HELMET CLEARANCE	12.4	6.5%	178.5	93.5%	.0	.0%	191.0	100.0%

APPENDIX F
Results of Statistical Tests on Workstation Data

FISHER'S EXACT TESTS TO DETERMINE INDEPENDENCE OF WEIGHT-FOR-HEIGHT STANDARD STATUS WITH ACCEPTABILTY

Workstation Item	Weight-for Hieight	
	Fisher's *F*	Exact *p*
Remove MKT Fire Extinguisher	0.358	.8872
Replace MKT Fire Extinguisher	n/a	n/a
Install MKT Utensil Holder	.8330	.3745
Raise MKT Range Cover	.3161	.5992
Release MKT Range Cover Prop	.8790	.3581
Lower MKT Range Cover	.6367	.4411
Replace HEMTT Engine Panel	.2232	.6875
Replace HEMTT Rear Hatch	.7866	.4588
Reach MEMTT V8 Valve	.1790	.7223
Reach HEMTT V7 Valve	.1999	.7679
Open HET Hood	.0716	.8414
Close HET Hood	.0442	.8690
Sight Forklift Forkends	2.5280	.1727
Sight 15ft Rear of Forklift	.0259	1.0000
Vision Out of Hatch	0.9598	.4312

REMOVE FIRE EXTINGUISHER											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	89	1556.4	44.99							
	Accept	111	1601.4	31.66	2.02	**.000^**			2158.0	6074.0	**.0000***
Eye Height, Sitting	Unaccept	88	718.59	25.67							
	Accept	111	734.42	26.69	1.08	.709	16.67	**.000***			
Func. Leg Lg.	Unaccept	89	958.32	39.92							
	Accept	110	990.46	29.32	7.85	**.002^**			2488.5	6404.5	**.0000***
Crotch Ht.	Unaccept	89	726.79	35.06							
	Accept	111	761.55	24.88	1.99	**.001^**			2218.5	6134.5	**.0000***
Hand Lg.	Unaccept	89	173.64	7.19							
	Accept	110	179.25	6.62	1.18	.412	35.12	**.000***			
Over Hd. Rch Ext.	Unaccept	89	2063.9	67.48							
	Accept	110	2138.8	47.64	2.01	**.001^**			1879.0	5365.0	**.0000***
Popliteal Height	Unaccept	89	350.14	17.05							
	Accept	110	365.78	12.72	1.8	**.004^**			2307.5	5793.5	**.0000***
Thumbtip Reach	Unaccept	89	699.24	31.74							
	Accept	111	724.25	23.74	1.79	**.004^**			2602.0	6088.0	**.0000***
Weight	Unaccept	89	57.78	7.94							
	Accept	110	60.52	8.62	1.18	.424	6.025	0.015			

^=Hetereogenous Variance (p <.05)

*=Significantly different at p <.05 using a Bonferroni Correction (p <.05/9=.0055)

MOBILE KITCHEN TRAILER MKT75

REPLACE FIRE EXTINGUISHER											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	103	1560	44.11							
	Accept	97	1604.7	30.68	2.07	**.000^**			2009.5	12430.5	**.0000***
Eye Height, Sitting	Unaccept	102	720.07	25.87							
	Accept	97	735.58	26.60	1.06	.781	16.21	**.000***			
Func. Leg Lg.	Unaccept	103	962.3	39.71							
	Accept	95	991.3	29.49	1.81	**.004^**			2515.0	11528.0	**.0000***
Crotch Ht.	Unaccept	103	729.93	34.59							
	Accept	97	763.56	24.58	1.98	**.001^**			2144.0	12296.0	**.0000***
Hand Lg.	Unaccept	103	174.29	7.017							
	Accept	95	179.46	6.904	1.03	.874	30.62	**.000***			
Over Hd. Rch Ext.	Unaccept	103	2069.9	65.67							
	Accept	95	2144.3	46.89	1.96	**.001^**			1860.0	12276.0	**.0000***
Popliteal Height	Unaccept	103	351.16	16.82							
	Accept	95	367.05	12.17	1.91	**.002^**			2284.0	11852.0	**.0000***
Thumbtip Reach	Unaccept	103	701.81	30.52							
	Accept	97	725.55	24.61	1.54	**.034^**			2756.5	11578.5	**.0000***
Weight	Unaccept	103	58.62	8.63							
	Accept	95	60.08	8.19	1.11	.606	2.081	0.151			

^=Hetereogenous Variance (p <.05)

*=Significantly different at p <.05 using a Bonferroni Correction (p <.05/9=.0055)

MOBILE KITCHEN TRAILER MKT75

INSTALL UTENSIL HOLDER											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	119	1567.77	40.44							
	Accept	42	1615.75	26.51	2.32	**.003^**			752.5	4868	**.0000***
Eye Height, Sitting	Unaccept	118	720.21	25.92							
	Accept	42	740.48	26.3	1.03	.879	15.540	**.000***			
Func. Leg Lg.	Unaccept	119	966.83	35.2							
	Accept	40	999.06	30.98	1.29	.363	26.239	**.000***			
Crotch Ht.	Unaccept	119	738.89	30.91							
	Accept	42	763.76	33.89	1.2	.443	16.914	**.000***			
Hand Lg.	Unaccept	119	176.01	6.92							
	Accept	41	181.31	7.82	1.28	.317	17.875	**.000***			
Over Hd. Rch Ext.	Unaccept	118	2086.29	63.6							
	Accept	42	2158.33	49.01	1.68	.059	14.795	**.000***			
Popliteal Height	Unaccept	119	354.61	15.74							
	Accept	41	370.31	12.89	1.49	.150	33.426	**.000***			
Thumbtip Reach	Unaccept	119	707.09	29.02							
	Accept	42	728.96	30.18	1.08	.726	18.157	**.000***			
Weight	Unaccept	118	58.72	7.85							
	Accept	42	61.96	8.46	1.16	.528	3.816	.053			

^=Hetereogenous Variance (p <.05)

*=Significantly different at p <.05 using a Bonferroni Correction (p <.05/9=.0055)

MOBILE KITCHEN TRAILER MKT75

RAISE RANGE COVER											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	Variance *p*	Main Effects F	Main Effects *p*	Mann-Whitney *U* *U*	Mann-Whitney *U* *W*	Mann-Whitney *U* *p*
Stature	Unaccept	40	1545.79	46.09							
	Accept	160	1590.31	39.00	1.40	.158	47.294	**.000***			
Eye Height, Sitting	Unaccept	40	718.67	26.80							
	Accept	159	729.65	27.11	1.02	.968	8.427	**.004***			
Func. Leg Lg.	Unaccept	40	950.36	37.73							
	Accept	159	982.57	35.23	1.15	.549	26.224	**.000***			
Crotch Ht.	Unaccept	40	722.89	33.36							
	Accept	160	751.93	32.25	1.07	.748	26.306	**.000***			
Hand Lg.	Unaccept	40	172.79	6.05							
	Accept	159	177.75	7.40	1.50	.139	15.136	**.000***			
Over Hd. Rch Ext.	Unaccept	40	2048.78	68.87							
	Accept	159	2119.60	60.46	1.30	.269	47.049	**.000***			
Popliteal Height	Unaccept	40	348.22	15.95							
	Accept	159	361.46	15.85	1.01	.919	23.341	**.000***			
Thumbtip Reach	Unaccept	40	689.66	28.03							
	Accept	160	719.02	27.83	1.01	.915	33.763	**.000***			
Weight	Unaccept	40	56.79	8.21							
	Accept	159	59.93	8.37	1.04	.920	3.992	.047			

^=Hetereogenous Variance (p <.05)

*=Significantly different at p <.05 using a Bonferroni Correction (p <.05/9=.0055)

RELEASE RANGE COVER PROP											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	60	1557.9	48.97							
	Accept	141	1591.4	37.91	1.67	**.015^**			2674.5	4417.5	**.0001***
Eye Height, Sitting	Unaccept	60	723.62	27.71							
	Accept	140	729.08	27.11	1.04	.820	3.966	.048			
Func. Leg Lg.	Unaccept	60	956.54	37.58							
	Accept	139	984.49	34.98			26.398	**.000***			
Crotch Ht.	Unaccept	60	728.41	32.97							
	Accept	141	753.67	32.29	1.04	.825	26.767	**.000***			
Hand Lg.	Unaccept	60	173.08	5.96							
	Accept	140	178.32	7.43	1.56	.056	23.071	**.000***			
Over Hd. Rch Ext.	Unaccept	60	2064.6	71.52							
	Accept	139	2122.9	58.92	1.47	.068	47.790	**.000***			
Popliteal Height	Unaccept	59	349.37	15.09							
	Accept	141	362.73	15.78	1.09	.709	32.761	**.000***			
Thumbtip Reach	Unaccept	60	695.21	29.05							
	Accept	141	720.79	27.38	1.13	.568	34.693	**.000***			
Weight	Unaccept	60	58.07	9.53							
	Accept	140	59.83	7.87	1.47	.070	1.892	.171			

^=Hetereogenous Variance (p <.05)

*=Significantly different at p <.05 using a Bonferroni Correction (p <.05/9=.0055)

LOWER MKT RANGE COVER											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	59	1556.97	49.04							
	Accept	142	1591.52	37.77	1.69	**.014^**			2389	4404.5	**.0000***
Eye Height, Sitting	Unaccept	59	722.85	27.46							
	Accept	141	729.36	27.16	1.02	.896	4.689	.032			
Func. Leg Lg.	Unaccept	59	955.73	37.53							
	Accept	140	984.59	34.85	1.16	.481	27.74	**.000***			
Crotch Ht.	Unaccept	59	728.05	33.22							
	Accept	142	753.60	32.16	1.07	.745	26.99	**.000***			
Hand Lg.	Unaccept	59	173.10	6.02							
	Accept	141	178.27	7.41	1.52	.071	22.02	**.000***			
Over Hd. Rch Ext.	Unaccept	59	2063.70	72.00							
	Accept	141	2122.74	58.69	1.51	.054	48.21	**.000***			
Popliteal Height	Unaccept	58	349.16	15.18							
	Accept	142	362.70	15.72	1.07	.781	33.16	**.000***			
Thumbtip Reach	Unaccept	59	694.33	28.68							
	Accept	142	720.94	27.31	1.1	.634	37.51	**.000***			
Weight	Unaccept	59	58.09	9.63							
	Accept	141	59.80	7.84	1.51	.052	1.644	.201			

^=Hetereogenous Variance (p <.05)

*=Significantly different at p <.05 using a Bonferroni Correction (p <.05/9=.0055)

REPLACE ENGINE PANEL

Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	Variance *p*	Main Effects F	Main Effects *p*	Mann-Whitney *U* *U*	Mann-Whitney *U* *W*	Mann-Whitney *U* *p*
Stature	Unaccept	29	1532.9	51.90							
	Accept	156	1592.3	35.27	2.17	**.003^**			919.5	1354.5	**.0000***
Eye Height, Sittir	Unaccept	29	711.31	28.49							
	Accept	155	730.94	25.25	1.27	.359	9.435	**.002***			
Func. Leg Lg.	Unaccept	29	944.03	42.45							
	Accept	154	982.73	34.04	1.56	.097	28.745	**.000***			
Crotch Ht.	Unaccept	29	711.2	34.04							
	Accept	156	753.91	30.01	1.29	.339	44.102	**.000***			
Hand Lg.	Unaccept	29	170.89	6.78							
	Accept	155	177.9	7.01	1.07	.875	27.169	**.000***			
Over Hd. Rch Ex	Unaccept	29	2027.9	80.10							
	Accept	155	2122.2	54.50	2.16	**.003^**			685.5	1280.5	**.0000***
Popliteal Height	Unaccept	29	341.33	16.77							
	Accept	155	362.56	14.38	1.36	.247	47.680	**.000***			
Thumbtip Reach	Unaccept	29	680.94	28.92							
	Accept	156	718.91	26.78	1.17	.545	47.646	**.000***			
Weight	Unaccept	29	56.92	9.30							
	Accept	156	59.8	8.28	1.26	.378	2.438	.120			

^=Hetereogenous Variance

*=Significantly different at $p < .05$ using a Bonferroni Correction ($p < .05/9 = .0055$)

CLOSE REAR HATCH											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	36	1520.5	33.83							
	Accept	159	1596.1	31.84	1.13	.603	158.66	**.000***			
Eye Height, Sitti	Unaccept	36	708.07	26.003							
	Accept	158	731.63	25.57	1.03	.854	21.584	**.000***			
Func. Leg Lg.	Unaccept	36	927.64	28.59							
	Accept	158	987.85	29.69	1.08	.822	118.43	**.000***			
Crotch Ht.	Unaccept	36	702.44	24.64							
	Accept	159	757.03	26.9	1.19	.554	118.35	**.000***			
Hand Lg.	Unaccept	36	169.76	5.93							
	Accept	158	178.44	6.79	1.31	.352	50.466	**.000***			
Over Hd. Rch Ex	Unaccept	36	2007.9	50.63							
	Accept	158	2128.9	47.85	1.12	.626	177.86	**.000***			
Popliteal Height	Unaccept	36	339.07	14.71							
	Accept	158	363.75	13.15	1.25	.356	97.288	**.000***			
Thumbtip Reach	Unaccept	36	675.94	22.7							
	Accept	159	721.23	24.96	1.21	.521	92.84	**.000***			
Weight	Unaccept	36	53.82	5.73							
	Accept	158	60.54	8.44	2.17	**.009^**			1306.5	1936.5	**.0000***

^=Hetereogenous Variance

*=Significantly different at $p < .05$ using a Bonferroni Correction ($p < .05/9 = .0055$)

REACH V8 FUEL FLOW VALVE											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	93	1562.4	39.87							
	Accept	49	1615.3	23.16	2.96	**.000^**			568.5	5360.5	**.0000***
Eye Height, Sittir	Unaccept	92	717.72	25.12							
	Accept	49	737.92	30.20	1.45	0.133	17.3	**.000***			
Func. Leg Lg.	Unaccept	92	966.22	35.08							
	Accept	48	996.1	28	1.57	0.091	25.59	**.000***			
Crotch Ht.	Unaccept	93	735.55	30.93							
	Accept	49	767.92	25.49	1.47	0.144	39.23	**.000***			
Hand Lg.	Unaccept	92	175.31	6.96							
	Accept	49	181.56	7.14	1.05	0.815	26.95	**.000***			
Over Hd. Rch Ex	Unaccept	93	2077.9	61.66							
	Accept	49	1.62.13	37.65	2.68	**.000^**			500.0*	5184	**.0000***
Popliteal Height	Unaccept	93	353.47	15.93							
	Accept	47	370.25	10.36	2.36	**.002^**			818.00	4726.00	**.0000***
Thumbtip Reach	Unaccept	93	704.05	29.8							
	Accept	49	731.67	25.88	1.33	0.286	31.001	**.000***			
Weight	Unaccept	92	59.03	8.54							
	Accept	49	60.34	7.2	1.41	0.197	0.919	0.334			

^=Hetereogenous Variance

*=Significantly different at $p < .05$ using a Bonferroni Correction ($p < .05/9 = .0055$)

M978 HEMTT FUEL TANKER

REACH V7 FUEL FLOW VALVE											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	130	1576.3	42.2							
	Accept	11	1629.4	11.81	12.76	**.000^**			170.0	1480.0	**.0000***
Eye Height, Sitti	Unaccept	129	723.47	28.28							
	Accept	11	738.75	29.21	1.07	.785	1.616	.206			
Func. Leg Lg.	Unaccept	128	973.77	35.28							
	Accept	11	1006.6	25.72	1.88	.258	8.824	**.004***			
Crotch Ht.	Unaccept	130	743.65	31.9							
	Accept	11	781.16	24.31	1.72	.333	14.732	**.000***			
Hand Lg.	Unaccept	129	176.89	7.18							
	Accept	11	184.11	9.38	1.71	.171	10.859	**.001***			
Over Hd. Rch Ex	Unaccept	130	2099.7	65.76							
	Accept	11	2187.9	18.79	12.25	**.000^**			127.5	1474.5	**.0000***
Popliteal Height	Unaccept	129	357.77	15.99							
	Accept	11	374.53	11.98	1.78	.303	11.257	**.001***			
Thumbtip Reach	Unaccept	130	711.18	30.34							
	Accept	11	740.33	31.15	1.05	.805	9.785	**.002***			
Weight	Unaccept	129	59.33	8.02							
	Accept	11	61.17	9.14	1.3	.475	0.228	.634			

^=Hetereogenous Variance

*=Significantly different at $p < .05$ using a Bonferroni Correction ($p < .05/9 = .0055$)

M1070 HEAVY EQUIPMENT TRANSPORT

OPEN HOOD												
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects *F*	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	30	1542.2	47.63							
	Accept	149	1589.2	36.38	1.71	**.041^**			944.5	1379.5	**.0000***
Eye Height, Sitti	Unaccept	30	716.58	25.53							
	Accept	48	729.3	26.71	1.09	.806	4.325	.039			
Func. Leg Lg.	Unaccept	30	944.97	39.11							
	Accept	48	981.03	31.71	1.52	.113	31.603	**.000***			
Crotch Ht.	Unaccept	30	717.37	33.94							
	Accept	49	751.31	29.69	1.31	.307	30.749	**.000***			
Hand Lg.	Unaccept	30	171.16	6.39							
	Accept	48	178.17	6.91	1.17	.638	27.411	**.000***			
Over Hd. Rch Ex	Unaccept	22	2024.9	84.27							
	Accept	162	2118.4	57.76	2.13	**.009^**			669.5	900.5	**.0000***
Popliteal Height	Unaccept	22	341.61	17.89							
	Accept	62	361.58	15.03	1.42	.234	31.425	**.000***			
Thumbtip Reach	Unaccept	22	681.21	31.78							
	Accept	163	717.21	27.63	1.32	.334	30.558	**.000***			
Weight	Unaccept	22	55.83	9.68							
	Accept	163	59.82	8.24	1.38	.269	3.492	**.000***			

^=Hetereogenous Variance (p <.05)

*=Significantly different at p <.05 using a Bonferroni Correction (p <.05/9=.0055)

M1070 HEAVY EQUIPMENT TRANSPORT

CLOSE HOOD											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	Variance *p*	Main Effects F	Main Effects *p*	Mann-Whitney *U* *U*	Mann-Whitney *U* *W*	Mann-Whitney *U* *p*
Stature	Unaccept	129	1574.10	42.14							
	Accept	50	1599.98	36.55	1.33	.257	16.028	**.000***			
Eye Height, Sitti	Unaccept	129	725.55	25.81							
	Accept	49	731.41	29.34	1.29	.261	2.288	.132			
Func. Leg Lg.	Unaccept	128	969.37	35.89							
	Accept	49	989.33	30.92	1.35	.238	12.333	**.001***			
Crotch Ht.	Unaccept	129	739.53	31.64							
	Accept	50	761.31	31.07	1.04	.906	16.706	**.000***			
Hand Lg.	Unaccept	128	176.12	7.26							
	Accept	50	1179.19	7.00	1.08	.789	5.095	.025			
Over Hd. Rch Ex	Unaccept	128	2092.46	65.03							
	Accept	50	2138.90	56.41	1.33	.257	19.662	**.000***			
Popliteal Height	Unaccept	129	356.21	15.76							
	Accept	49	365.04	15.50	1.03	.919	12.409	**.001***			
Thumbtip Reach	Unaccept	129	708.49	29.95							
	Accept	50	724.83	28.22	1.13	.646	11.755	**.001***			
Weight	Unaccept	128	59.07	8.15							
	Accept	50	60.18	8.41	1.07	.763	0.567	.453			

^=Hetereogenous Variance (p <.05)

*=Significantly different at p <.05 using a Bonferroni Correction (p <.05/9=.0055)

SIGHT FORKENDS											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	54	1538.25	42.69							
	Accept	145	1587.00	43.44	1.04	.906	9.336	**.003***			
Eye Height, Sitting	Unaccept	53	720.33	28.02							
	Accept	145	729.75	26.65	1.11	.633	5.844	.017			
Func. Leg Lg.	Unaccept	53	964.06	36.63							
	Accept	144	981.25	37.25	1.03	.912	8.576	**.004***			
Crotch Ht.	Unaccept	54	739.70	37.00							
	Accept	145	749.36	32.71	1.28	.256	4.229	.041			
Hand Lg.	Unaccept	53	175.35	6.54							
	Accept	145	177.52	7.73	1.40	.167	4.026	.046			
Over Hd. Rch Ext.	Unaccept	54	2089.19	72.05							
	Accept	144	2112.34	65.21	1.22	.356	6.429	.012			
Popliteal Height	Unaccept	53	355.83	18.79							
	Accept	145	360.43	15.48	1.47	.076	3.210	.075			
Thumbtip Reach	Unaccept	54	706.45	33.65							
	Accept	145	715.90	28.37	1.41	.117	4.297	.040			
Weight	Unaccept	54	58.13	7.90							
	Accept	144	59.86	8.64	1.2	.456	2.594	.109			

^=Hetereogenous Variance (p <.05)

*=Significantly different at p <.05 using a Bonferroni Correction (p <.05/9=.0055)

SIGHT 15FT REARWARD											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	33	1590.80	41.41							
	Accept	169	1580.41	44.26	1.14	.679	1.023	.313			
Eye Height, Sittin	Unaccept	33	733.17	32.45							
	Accept	168	726.30	26.15	1.54	.086	1.300	.256			
Func. Leg Lg.	Unaccept	33	978.06	33.00							
	Accept	167	976.43	38.54	1.36	.305	.048	.826			
Crotch Ht.	Unaccept	33	745.65	26.88							
	Accept	169	747.09	35.30	1.72	.073	.111	.739			
Hand Lg.	Unaccept	33	178.72	6.55							
	Accept	168	176.56	7.57	1.34	.340	2.455	.119			
Over Hd. Rch Ext	Unaccept	33	2124.71	62.51							
	Accept	168	2102.81	68.37	1.20	.566	1.467	.227			
Popliteal Height	Unaccept	31	360.65	13.29							
	Accept	169	358.96	16.99	1.63	.111	.159	.691			
Thumbtip Reach	Unaccept	33	714.84	28.86							
	Accept	169	713.09	30.37	1.11	.720	.169	.681			
Weight	Unaccept	33	61.14	9.09							
	Accept	168	59.04	8.27	1.21	.442	2.173	.142			

^=Hetereogenous Variance (p <.05)

*=Significantly different at p <.05 using a Bonferroni Correction (p <.05/9=.0055)

VISION OUT OF HATCH											
Anthropometric Variables	Difficulty Level	n	Mean	s.d.	Variance *F*	*p*	Main Effects *F*	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature	Unaccept	31	1540.48	51.09							
	Accept	158	1590.99	37.62	1.84	**.017^**			1025.0	1431.0	**.0000***
Eye Height, Sittir	Unaccept	31	706.22	25.16							
	Accept	157	732.61	25.66	1.04	.941	16.930	**.000***			
Func. Leg Lg.	Unaccept	31	961.01	47.74							
	Accept	156	980.60	34.38	1.93	**.011^**			1766.0	2172.0	.0743
Crotch Ht.	Unaccept	31	730.00	40..61							
	Accept	158	750.56	31.43	1.67	**.048^**			1658.0	2064.0	.0257
Hand Lg.	Unaccept	31	172.87	6.66							
	Accept	157	177.62	7.39	1.23	.510	11.463	**.001***			
Over Hd. Rch Ex	Unaccept	31	2055.41	81.14							
	Accept	157	2118.44	58.71	1.91	**.012^**			1272.0	1833.0	**.0000***
Popliteal Height	Unaccept	31	349.74	20.26							
	Accept	157	361.17	15.04	1.81	**.021^**			1525.0	2086.0	**.0003***
Thumbtip Reach	Unaccept	31	700.61	34.12							
	Accept	158	716.19	28.32	1.45	.151	5.713	.018			
Weight	Unaccept	31	55.99	9.53							
	Accept	157	60.19	8.01	1.42	.179	4.954	.027			

^=Heterogeous Variance (p<.05)
*=Significantly different at p<.05 using a Bonferroni Correction (p<.05/9=.0055)

APPENDIX G
Frequencies for Acceptability and Unacceptability of All Clothing/ Individual Equipment Items

CW TRIGGER FINGER MITTEN ACCEPTABILITY BY STATIC FIT VARIABLES

	CW TRIGGER FINGER MITTEN ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Not seated						
Satisfactory	4.6	58.9%	168.2	86.8%	172.8	85.7%
Crotch	2.5	32.4%	23.3	12.0%	25.8	12.8%
Missing	.0	.0%	2.4	1.2%	2.4	1.2%
Thb/Crh	.7	8.7%	.0	.0%	.7	.3%
Group Total	7.8	100.0%	193.8	100.0%	201.6	100.0%
Thumb Extend >3/8"						
No	5.3	67.4%	.0	.0%	5.3	2.6%
Yes	2.5	32.6%	192.6	99.4%	195.2	96.8%
Missing	.0	.0%	1.2	.6%	1.2	.6%
Group Total	7.8	100.0%	193.8	100.0%	201.6	100.0%
Hand Extends >5/8"						
No	7.8	100.0%	1.8	1.0%	9.6	4.8%
Yes	.0	.0%	190.8	98.4%	190.8	94.6%
Missing	.0	.0%	1.2	.6%	1.2	.6%
Group Total	7.8	100.0%	193.8	100.0%	201.6	100.0%
Constricts hand/ fingers						
satisfactory	7.8	100.0%	191.9	99.0%	199.7	99.1%
Missing	.0	.0%	1.9	1.0%	1.9	.9%
Group Total	7.8	100.0%	193.8	100.0%	201.6	100.0%
Excess Hand Circumference >1 5/8"						
No	7.8	100.0%	186.1	96.9%	193.9	97.1%
Yes	.0	.0%	5.9	3.1%	5.9	2.9%
Group Total	7.8	100.0%	191.9	100.0%	199.7	100.0%

CW TRIGGER FINGER MITTEN ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	CW TRIGGER FINGER MITTEN ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Make Fist						
Not hindered	6.6	84.9%	4.4	2.3%	11.0	5.5%
Hindered	1.2	15.1%	186.4	96.2%	187.5	93.0%
Missing	.0	.0%	3.0	1.6%	3.0	1.5%
Group Total	7.8	100.0%	193.8	100.0%	201.6	100.0%
Flex Index Finger						
Not hindered	3.9	49.9%	5.1	2.6%	9.0	4.4%
Hindered	3.2	41.3%	188.7	97.4%	192.0	95.2%
Missing	.7	8.7%	.0	.0%	.7	.3%
Group Total	7.8	100.0%	193.8	100.0%	201.6	100.0%
Flex Wrist						
Not hindered	7.8	100.0%	192.6	99.4%	200.4	99.4%
Missing	.0	.0%	1.2	.6%	1.2	.6%
Group Total	7.8	100.0%	193.8	100.0%	201.6	100.0%
Doff						
Not hindered	6.6	100.0%	191.0	100.0%	197.6	100.0%
Group Total	6.6	100.0%	191.0	100.0%	197.6	100.0%

CVC COVERALL ACCEPTABILITY BY STATIC FIT VARIABLES

	CVC COVERALL ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Waistband Location						
Satisfactory	15.7	67.4%	108.0	60.6%	123.7	61.4%
Above	.0	.0%	1.2	.7%	1.2	.6%
Below	7.6	32.6%	69.1	38.8%	76.7	38.0%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Sleeve Cuff Location						
Satisfactory	20.1	86.2%	130.0	72.9%	150.1	74.4%
Below	2.0	8.8%	47.6	26.7%	49.7	24.6%
Missing	1.2	5.0%	.7	.4%	1.8	.9%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Bust Fit						
Satisfactory	20.9	89.9%	139.6	78.3%	160.5	79.6%
Loose	1.2	5.0%	36.5	20.5%	37.7	18.7%
Missing	1.2	5.1%	2.2	1.3%	3.4	1.7%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Back Fit						
Satisfactory	5.6	24.2%	14.8	8.3%	20.5	10.2%
Tight	.0	.0%	3.5	2.0%	3.5	1.7%
Loose	17.6	75.8%	159.3	89.3%	176.9	87.8%
Missing	.0	.0%	.7	.4%	.7	.3%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Buttock Fit						
Satisfactory	19.2	82.4%	136.1	76.3%	155.3	77.0%
Tight	4.1	17.6%	25.9	14.5%	30.0	14.9%
Loose	.0	.0%	15.6	8.7%	15.6	7.7%
Missing	.0	.0%	.7	.4%	.7	.3%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Abdomen Fit						
Satisfactory	18.5	79.5%	145.3	81.5%	163.8	81.3%
Tight	4.1	17.6%	22.8	12.8%	26.9	13.3%
Loose	.0	.0%	10.2	5.7%	10.2	5.1%
Missing	.7	2.9%	.0	.0%	.7	.3%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%

(continued)

CVC COVERALL ACCEPTABILITY BY STATIC FIT VARIABLES

	CVC COVERALL ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Waist Fit						
Satisfactory	22.1	94.9%	141.7	79.5%	163.8	81.3%
Loose	1.2	5.1%	35.9	20.1%	37.1	18.4%
Missing	.0	.0%	.7	.4%	.7	.3%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Knee Pleat Location						
Satisfactory	15.6	67.0%	99.1	55.6%	114.7	56.9%
Below	6.5	28.0%	72.1	40.4%	78.6	39.0%
Missing	1.2	5.1%	7.2	4.0%	8.3	4.1%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Crotch Location						
Satisfactory	11.9	51.1%	19.8	11.1%	31.7	15.7%
More	11.4	48.9%	155.8	87.4%	167.2	82.9%
Less	.0	.0%	1.5	.9%	1.5	.8%
Missing	.0	.0%	1.2	.7%	1.2	.6%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Inseam Length						
No	23.3	100.0%	164.3	92.1%	187.6	93.0%
Yes	.0	.0%	12.9	7.2%	12.9	6.4%
Missing	.0	.0%	1.2	.7%	1.2	.6%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Shoulder Seam Location						
No	23.3	100.0%	148.3	83.2%	171.6	85.1%
Yes	.0	.0%	28.8	16.2%	28.8	14.3%
Missing	.0	.0%	1.2	.7%	1.2	.6%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Chest Exposure						
No	23.3	100.0%	154.5	86.6%	177.8	88.2%
Yes	.0	.0%	23.8	13.4%	23.8	11.8%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Reach Pocket Bottom						

(continued)

CVC COVERALL ACCEPTABILITY BY STATIC FIT VARIABLES

	CVC COVERALL ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
No	5.1	21.7%	12.5	7.0%	17.6	8.7%
Yes	18.2	78.3%	164.6	92.3%	182.9	90.7%
Missing	.0	.0%	1.2	.7%	1.2	.6%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Pocket Fit						
No	23.3	100.0%	165.3	94.3%	188.6	95.0%
Yes	.0	.0%	10.0	5.7%	10.0	5.0%
Group Total	23.3	100.0%	175.3	100.0%	198.6	100.0%

CVC COVERALL ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	CVC COVERALL ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
March in Place						
Not hindered	22.6	97.1%	50.8	28.5%	73.4	36.4%
Hindered	.7	2.9%	126.8	71.1%	127.5	63.2%
Missing	.0	.0%	.7	.4%	.7	.3%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Squat						
Not hindered	21.7	93.3%	127.1	71.3%	148.8	73.8%
Hindered	.0	.0%	48.0	26.9%	48.0	23.8%
Missing	1.5	6.7%	3.2	1.8%	4.8	2.4%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Bend At Waist						
Not hindered	21.4	92.1%	143.6	80.5%	165.0	81.8%
Hindered	.7	2.9%	34.8	19.5%	35.5	17.6%
Missing	1.2	5.0%	.0	.0%	1.2	.6%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Turn Head						
Missing	23.3	100.0%	178.3	100.0%	201.6	100.0%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Reach Front						
Not hindered	22.6	97.1%	154.5	86.6%	177.1	87.8%
Hindered	.7	2.9%	5.6	3.1%	6.3	3.1%
Missing	.0	.0%	18.3	10.2%	18.3	9.1%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Reach Side						
Not hindered	23.3	100.0%	83.7	46.9%	106.9	53.0%
Hindered	.0	.0%	93.0	52.2%	93.0	46.1%
Missing	.0	.0%	1.7	.9%	1.7	.8%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Reach Up						
Not hindered	22.6	97.1%	74.2	41.6%	96.8	48.0%
Hindered	.7	2.9%	104.1	58.4%	104.8	52.0%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%
Climb						

(continued)

CVC COVERALL ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	CVC COVERALL ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Not hindered	22.6	97.1%	77.9	43.7%	100.5	49.8%
Hindered	.7	2.9%	97.4	54.6%	98.1	48.6%
Missing	.0	.0%	3.0	1.7%	3.0	1.5%
Group Total	23.3	100.0%	178.3	100.0%	201.6	100.0%

MECHANICS' COVERALL ACCEPTABILITY BY STATIC FIT VARIABLES

	MECHANICS' COVERALL ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Waist Fit						
Satisfactory	45.5	79.7%	112.8	78.0%	158.2	78.5%
Tight	5.4	9.6%	19.5	13.5%	24.9	12.4%
Loose	.0	.0%	12.3	8.5%	12.3	6.1%
Missing	6.1	10.7%	.0	.0%	6.1	3.0%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Knee Pleat Location						
Satisfactory	5.7	10.1%	11.1	7.7%	16.8	8.3%
Missing	51.3	89.9%	133.5	92.3%	184.8	91.7%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Crotch Location						
Satisfactory	6.2	10.9%	3.7	2.5%	9.9	4.9%
More	44.7	78.4%	138.7	95.9%	183.3	90.9%
Missing	6.1	10.7%	2.2	1.5%	8.3	4.1%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Inseam Length						
No	49.5	86.9%	74.3	51.4%	123.9	61.4%
Yes	1.4	2.4%	69.6	48.1%	70.9	35.2%
Missing	6.1	10.7%	.7	.5%	6.8	3.4%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Shoulder Seam Location						
No	29.9	52.4%	64.0	44.2%	93.8	46.5%
Yes	21.1	36.9%	80.6	55.8%	101.7	50.4%
Missing	6.1	10.7%	.0	.0%	6.1	3.0%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Chest Exposure						
No	50.9	89.3%	142.0	98.2%	192.9	95.7%
Yes	.0	.0%	2.5	1.8%	2.5	1.3%
Missing	6.1	10.7%	.0	.0%	6.1	3.0%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%

(continued)

MECHANICS' COVERALL ACCEPTABILITY BY STATIC FIT VARIABLES

	MECHANICS' COVERALL ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Waistband Location						
Satisfactory	36.9	64.6%	73.8	51.1%	110.7	54.9%
Above	.0	.0%	3.0	2.1%	3.0	1.5%
Below	13.4	23.4%	65.9	45.6%	79.2	39.3%
Missing	6.8	11.9%	1.8	1.3%	8.6	4.3%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Sleeve Cuff Location						
Satisfactory	29.5	51.7%	26.6	18.4%	56.1	27.8%
Above	.0	.0%	.7	.5%	.7	.3%
Below	20.7	36.3%	114.3	79.1%	135.0	67.0%
Missing	6.8	11.9%	3.0	2.1%	9.8	4.9%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Bust Fit						
Satisfactory	45.6	80.0%	94.9	65.7%	140.6	69.7%
Tight	1.5	2.7%	9.7	6.7%	11.3	5.6%
Loose	3.7	6.5%	39.9	27.6%	43.6	21.6%
Missing	6.1	10.7%	.0	.0%	6.1	3.0%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Back Fit						
Satisfactory	47.5	83.3%	82.6	57.1%	130.1	64.5%
Tight	.0	.0%	1.8	1.3%	1.8	.9%
Loose	3.4	6.0%	59.0	40.8%	62.4	30.9%
Missing	6.1	10.7%	1.2	.8%	7.3	3.6%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Buttock Fit						
Satisfactory	47.9	84.0%	100.2	69.3%	148.1	73.5%
Tight	.0	.0%	9.5	6.6%	9.5	4.7%
Loose	3.0	5.3%	32.1	22.2%	35.1	17.4%
Missing	6.1	10.7%	2.7	1.9%	8.8	4.4%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Abdomen Fit						
Satisfactory	45.6	80.0%	83.2	57.6%	128.9	63.9%
Tight	2.7	4.8%	26.5	18.3%	29.2	14.5%
Loose	2.5	4.5%	34.9	24.1%	37.4	18.6%
Missing	6.1	10.7%	.0	.0%	6.1	3.0%

(continued)

MECHANICS' COVERALL ACCEPTABILITY BY STATIC FIT VARIABLES

	MECHANICS' COVERALL ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Reach Pocket Bottom						
No	40.1	70.3%	74.1	51.2%	114.2	56.6%
Yes	10.8	18.9%	70.5	48.8%	81.3	40.3%
Missing	6.1	10.7%	.0	.0%	6.1	3.0%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Pocket Fit						
No	44.9	78.7%	117.8	81.5%	162.6	80.7%
Yes	6.0	10.6%	26.8	18.5%	32.8	16.3%
Missing	6.1	10.7%	.0	.0%	6.1	3.0%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%

MECHANICS' COVERALL ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	MECHANICS' COVERALL ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
March in Place						
Not hindered	49.9	87.5%	86.3	59.7%	136.2	67.6%
Hindered	1.0	1.8%	58.3	40.3%	59.3	29.4%
Missing	6.1	10.7%	.0	.0%	6.1	3.0%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Squat						
Not hindered	48.5	85.1%	108.2	74.8%	156.7	77.8%
Hindered	2.4	4.1%	30.6	21.2%	33.0	16.4%
Missing	6.1	10.7%	5.7	4.0%	11.9	5.9%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Bend at Waist						
Not hindered	48.5	85.1%	112.2	77.6%	160.8	79.7%
Hindered	2.4	4.1%	31.2	21.6%	33.6	16.6%
Missing	6.1	10.7%	1.2	.8%	7.3	3.6%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Turn Head						
Missing	57.0	100.0%	144.6	100.0%	201.6	100.0%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Reach Front						
Not hindered	50.9	89.3%	132.9	91.9%	183.8	91.2%
Hindered	.0	.0%	6.9	4.8%	6.9	3.4%
Missing	6.1	10.7%	4.8	3.3%	10.9	5.4%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Reach Side						
Not hindered	50.9	89.3%	121.1	83.8%	172.0	85.3%
Hindered	.0	.0%	22.3	15.4%	22.3	11.1%
Missing	6.1	10.7%	1.2	.8%	7.3	3.6%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%
Reach Up						
Not hindered	50.9	89.3%	125.9	87.1%	176.8	87.7%
Hindered	.0	.0%	17.5	12.1%	17.5	8.7%
Missing	6.1	10.7%	1.2	.8%	7.3	3.6%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%

(continued)

MECHANICS' COVERALL ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	MECHANICS' COVERALL ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Climb						
Not hindered	49.2	86.3%	85.5	59.2%	134.8	66.9%
Hindered	1.7	2.9%	57.7	39.9%	59.3	29.4%
Missing	6.1	10.7%	1.4	.9%	7.5	3.7%
Group Total	57.0	100.0%	144.6	100.0%	201.6	100.0%

ALICE FRAME WITH PACK ACCEPTABILITY BY STATIC FIT VARIABLES

	ALICE ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Frame Contact						
No	74.5	96.1%	115.5	93.1%	190.0	94.3%
Yes	1.2	1.5%	8.5	6.9%	9.7	4.8%
Missing	1.9	2.4%	.0	.0%	1.9	.9%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Waist Belt w/ PASGT						
No	7.0	9.1%	3.7	3.0%	10.7	5.3%
Yes	68.6	88.5%	120.3	97.0%	189.0	93.7%
Missing	1.9	2.4%	.0	.0%	1.9	.9%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Waist Belt Location						
Satisfactory	72.7	93.7%	121.5	98.0%	194.2	96.3%
Below	3.0	3.9%	2.5	2.0%	5.6	2.8%
Missing	1.9	2.4%	.0	.0%	1.9	.9%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Frame Slippage						
Satisfactory	73.3	94.6%	121.0	97.6%	194.4	96.4%
Vertical	1.2	1.5%	2.3	1.9%	3.5	1.7%
Horizontal	.0	.0%	.7	.5%	.7	.3%
Missing	3.0	3.9%	.0	.0%	3.0	1.5%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Lumbar Pad Location						
Satisfactory	56.4	72.7%	65.1	52.5%	121.5	60.3%
Below	19.3	24.9%	58.9	47.5%	78.3	38.8%
Missing	1.9	2.4%	.0	.0%	1.9	.9%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Pack Location						
No	72.7	93.7%	90.5	72.9%	163.2	80.9%
Yes	3.0	3.9%	33.6	27.1%	36.6	18.1%
Missing	1.9	2.4%	.0	.0%	1.9	.9%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%

(continued)

ALICE FRAME WITH PACK ACCEPTABILITY BY STATIC FIT VARIABLES

	ALICE ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
arms contact frame						
No	60.7	82.2%	72.7	58.6%	133.4	67.4%
Yes	13.2	17.8%	51.3	41.4%	64.5	32.6%
Group Total	73.8	100.0%	124.0	100.0%	197.9	100.0%

ALICE FRAME WITH PACK ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	ALICE ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
March in Place						
Not hindered	75.0	96.7%	111.1	89.5%	186.1	92.3%
Hindered	.0	.0%	13.0	10.5%	13.0	6.4%
Missing	2.5	3.3%	.0	.0%	2.5	1.3%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Squat						
Not hindered	62.0	79.9%	30.1	24.2%	92.1	45.7%
Hindered	11.9	15.3%	94.0	75.8%	105.8	52.5%
Missing	3.7	4.8%	.0	.0%	3.7	1.8%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Bend at Waist						
Not hindered	55.1	71.0%	32.8	26.5%	87.9	43.6%
Hindered	20.0	25.7%	91.2	73.5%	111.2	55.1%
Missing	2.5	3.3%	.0	.0%	2.5	1.3%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Turn Head						
Not hindered	73.8	95.2%	124.0	100.0%	197.9	98.2%
Hindered	1.8	2.4%	.0	.0%	1.8	.9%
Missing	1.9	2.4%	.0	.0%	1.9	.9%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Reach Front						
Not hindered	47.1	60.8%	16.9	13.6%	64.0	31.8%
Hindered	27.4	35.3%	107.2	86.4%	134.6	66.7%
Missing	3.0	3.9%	.0	.0%	3.0	1.5%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Reach Side						
Not hindered	72.0	92.8%	122.9	99.1%	194.9	96.7%
Hindered	1.8	2.4%	.0	.0%	1.8	.9%
Missing	3.7	4.8%	1.2	.9%	4.9	2.4%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Reach Up						
Not hindered	59.8	77.1%	40.7	32.8%	100.5	49.8%
Hindered	15.9	20.5%	83.4	67.2%	99.3	49.3%
Missing	1.9	2.4%	.0	.0%	1.9	.9%

(continued)

ALICE FRAME WITH PACK ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	ALICE ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%
Climb						
Not hindered	69.9	90.2%	38.2	30.8%	108.1	53.6%
Hindered	5.1	6.5%	85.9	69.2%	91.0	45.1%
Missing	2.5	3.3%	.0	.0%	2.5	1.3%
Group Total	77.5	100.0%	124.0	100.0%	201.6	100.0%

PASGT VEST ACCEPTABILITY BY STATIC FIT VARIABLES

	PASGT VEST ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Chest Exposure						
No	113.9	99.4%	87.0	100.0%	200.9	99.7%
Missing	.7	.6%	.0	.0%	.7	.3%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Waist Length						
Satisfactory	.7	.6%	.7	.8%	1.4	.7%
Above	.0	.0%	1.2	1.4%	1.2	.6%
Below	113.3	98.8%	85.1	97.9%	198.4	98.4%
Missing	.7	.6%	.0	.0%	.7	.3%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Vest Slippage						
Minimal	68.5	59.8%	39.2	45.1%	107.7	53.4%
Vertical	33.0	28.8%	24.3	27.9%	57.3	28.4%
Horizontal	4.2	3.7%	9.3	10.7%	13.5	6.7%
Both	7.1	6.2%	12.4	14.2%	19.4	9.6%
Missing	1.9	1.6%	1.8	2.1%	3.7	1.8%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Chest Compression						
No	113.9	99.4%	87.0	100.0%	200.9	99.7%
Missing	.7	.6%	.0	.0%	.7	.3%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Collar Overlap						
Satisfactory	103.1	90.0%	61.5	70.7%	164.6	81.7%
Jaw	9.6	8.4%	25.5	29.3%	35.1	17.4%
Missing	1.9	1.6%	.0	.0%	1.9	.9%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Shoulder Pad Location						
No	113.9	99.4%	84.9	97.7%	198.9	98.7%
Yes	.0	.0%	2.0	2.3%	2.0	1.0%
Missing	.7	.6%	.0	.0%	.7	.3%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%

PASGT VEST ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	PASGT VEST ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
March in Place						
Not hindered	110.5	96.4%	81.5	93.8%	192.1	95.3%
Hindered	1.5	1.4%	5.4	6.2%	7.0	3.5%
Missing	2.5	2.2%	.0	.0%	2.5	1.3%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Squat						
Not hindered	92.7	80.8%	12.9	14.9%	105.6	52.4%
Hindered	19.4	16.9%	74.0	85.1%	93.5	46.4%
Missing	2.5	2.2%	.0	.0%	2.5	1.3%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Bend At Waist						
Not hindered	77.4	67.5%	6.7	7.7%	84.1	41.7%
Hindered	35.4	30.9%	80.3	92.3%	115.7	57.4%
Missing	1.9	1.6%	.0	.0%	1.9	.9%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Turn Head						
Not hindered	112.8	98.4%	85.1	97.9%	197.9	98.2%
Hindered	.0	.0%	1.8	2.1%	1.8	.9%
Missing	1.9	1.6%	.0	.0%	1.9	.9%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Reach Front						
Not hindered	95.5	83.3%	32.8	37.7%	128.3	63.6%
Hindered	17.3	15.1%	54.2	62.3%	71.5	35.5%
Missing	1.9	1.6%	.0	.0%	1.9	.9%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Reach Side						
Not hindered	112.8	98.4%	87.0	100.0%	199.7	99.1%
Missing	1.9	1.6%	.0	.0%	1.9	.9%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%
Reach Up						
Not hindered	91.9	80.2%	19.1	21.9%	111.0	55.0%
Hindered	20.9	18.2%	67.9	78.1%	88.8	44.0%
Missing	1.9	1.6%	.0	.0%	1.9	.9%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%

(continued)

PASGT VEST ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	PASGT VEST ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Climb						
Not hindered	111.4	97.2%	41.6	47.8%	153.0	75.9%
Hindered	.7	.6%	45.4	52.2%	46.1	22.9%
Missing	2.5	2.2%	.0	.0%	2.5	1.3%
Group Total	114.6	100.0%	87.0	100.0%	201.6	100.0%

ENHANCED TACTICAL LOAD BEARING VEST ACCEPTABILITY BY STATIC FIT VARIABLES

	LOAD BEARING VEST ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Chest Strap Location						
Satisfactory	40.9	28.6%	7.6	13.0%	48.5	24.0%
At	82.7	57.8%	38.2	65.2%	120.9	60.0%
Below	17.6	12.3%	12.7	21.8%	30.4	15.1%
Missing	1.9	1.3%	.0	.0%	1.9	.9%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Waist Belt w/ PASGT						
No	138.3	96.7%	57.4	98.0%	195.7	97.1%
Yes	2.7	1.9%	1.2	2.0%	3.9	1.9%
Missing	2.0	1.4%	.0	.0%	2.0	1.0%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Waist Belt Location						
Satisfactory	3.6	2.5%	1.2	2.0%	4.8	2.4%
Above	.0	.0%	1.2	2.0%	1.2	.6%
Below	138.8	97.0%	56.2	96.0%	195.0	96.7%
Missing	.7	.5%	.0	.0%	.7	.3%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Vest Slippage						
Satisfactory	142.4	99.5%	58.5	100.0%	200.9	99.7%
Missing	.7	.5%	.0	.0%	.7	.3%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Accommodation of Shovel, Canteens						
No	142.4	99.5%	58.5	100.0%	200.9	99.7%
Missing	.7	.5%	.0	.0%	.7	.3%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Shoulder Pad Location						
No	142.4	99.5%	58.5	100.0%	200.9	99.7%
Missing	.7	.5%	.0	.0%	.7	.3%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%

ENHANCED TACTICAL LOAD BEARING VEST ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	LOAD BEARING VEST ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
March in Place						
Not hindered	139.9	97.8%	24.0	41.1%	163.9	81.3%
Hindered	.7	.5%	34.5	58.9%	35.2	17.4%
Missing	2.5	1.8%	.0	.0%	2.5	1.3%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Squat						
Not hindered	117.0	81.7%	.0	.0%	117.0	58.0%
Hindered	23.6	16.5%	58.5	100.0%	82.1	40.7%
Missing	2.5	1.8%	.0	.0%	2.5	1.3%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Bend at Waist						
Not hindered	117.7	82.3%	2.8	4.9%	120.5	59.8%
Hindered	22.8	16.0%	55.7	95.1%	78.5	38.9%
Missing	2.5	1.8%	.0	.0%	2.5	1.3%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Turn Head						
Not hindered	141.2	98.7%	58.5	100.0%	199.7	99.1%
Missing	1.9	1.3%	.0	.0%	1.9	.9%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Reach Front						
Not hindered	141.2	98.7%	57.8	98.8%	199.1	98.7%
Hindered	.0	.0%	.7	1.2%	.7	.3%
Missing	1.9	1.3%	.0	.0%	1.9	.9%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Reach Side						
Not hindered	141.2	98.7%	58.5	100.0%	199.7	99.1%
Missing	1.9	1.3%	.0	.0%	1.9	.9%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%
Reach Up						
Not hindered	140.5	98.2%	52.1	89.0%	192.6	95.5%
Hindered	.7	.5%	6.4	11.0%	7.1	3.5%
Missing	1.9	1.3%	.0	.0%	1.9	.9%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%

(continued)

ENHANCED TACTICAL LOAD BEARING VEST ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	LOAD BEARING VEST ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Climb						
Not hindered	129.9	90.8%	5.8	9.8%	135.7	67.3%
Hindered	10.6	7.4%	52.8	90.2%	63.4	31.4%
Missing	2.5	1.8%	.0	.0%	2.5	1.3%
Group Total	143.1	100.0%	58.5	100.0%	201.6	100.0%

	ECWCS PARKA ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Snow Skirt Location						
Satisfactory	110.3	74.5%	29.2	54.6%	139.5	69.2%
Above	1.4	.9%	.7	1.3%	2.0	1.0%
Below	31.4	21.2%	23.6	44.1%	55.0	27.3%
Missing	5.0	3.4%	.0	.0%	5.0	2.5%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Sleeve Cuff Location						
Satisfactory	65.2	44.0%	3.9	7.3%	69.1	34.3%
Below	77.2	52.1%	48.9	91.4%	126.1	62.5%
Missing	5.7	3.9%	.7	1.3%	6.4	3.2%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Bust Fit						
Satisfactory	144.2	97.4%	46.2	86.4%	190.4	94.5%
Tight	1.2	.8%	.0	.0%	1.2	.6%
Loose	.0	.0%	7.3	13.6%	7.3	3.6%
Missing	2.7	1.8%	.0	.0%	2.7	1.3%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Back Fit						
Satisfactory	145.4	98.2%	49.8	93.1%	195.2	96.8%
Tight	.0	.0%	1.8	3.4%	1.8	.9%
Loose	.0	.0%	1.9	3.5%	1.9	.9%
Missing	2.7	1.8%	.0	.0%	2.7	1.3%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Buttock Fit						
Satisfactory	141.1	95.3%	45.2	84.5%	186.3	92.4%
Tight	2.9	2.0%	6.2	11.6%	9.1	4.5%
Loose	1.4	.9%	2.0	3.8%	3.4	1.7%
Missing	2.7	1.8%	.0	.0%	2.7	1.3%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Abdomen Fit						
Satisfactory	142.9	96.4%	43.0	80.3%	185.8	92.2%
Tight	1.5	1.0%	2.9	5.4%	4.5	2.2%
Loose	1.0	.7%	7.6	14.2%	8.6	4.3%
Missing	2.7	1.8%	.0	.0%	2.7	1.3%

(continued)

ECWCS PARKA ACCEPTABILITY BY STATIC FIT VARIABLES

	ECWCS PARKA ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Waist Fit						
Satisfactory	143.2	96.7%	46.7	87.3%	189.9	94.2%
Tight	.0	.0%	2.2	4.2%	2.2	1.1%
Loose	2.2	1.5%	4.6	8.6%	6.8	3.4%
Missing	2.7	1.8%	.0	.0%	2.7	1.3%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Snow Skirt Fit						
Satisfactory	107.0	72.2%	23.6	44.1%	130.5	64.8%
Tight	19.5	13.2%	29.2	54.6%	48.7	24.2%
Missing	21.7	14.6%	.7	1.3%	22.4	11.1%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Hood Visor Location						
No	89.7	60.5%	23.5	43.9%	113.2	56.1%
Yes	49.7	33.5%	30.0	56.1%	79.7	39.5%
Missing	8.8	5.9%	.0	.0%	8.8	4.3%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Gape at Neck						
No	142.4	96.1%	50.9	95.3%	193.3	95.9%
Missing	5.7	3.9%	2.5	4.7%	8.3	4.1%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Reach Pocket Bottom						
No	134.5	90.8%	43.0	80.4%	177.5	88.1%
Yes	6.8	4.6%	9.8	18.3%	16.6	8.2%
Missing	6.8	4.6%	.7	1.3%	7.5	3.7%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Parka Length						
No	140.0	94.5%	52.1	97.5%	192.1	95.3%
Yes	1.4	.9%	1.4	2.5%	2.7	1.3%
Missing	6.8	4.6%	.0	.0%	6.8	3.4%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%

(continued)

ECWCS PARKA ACCEPTABILITY BY STATIC FIT VARIABLES

	ECWCS PARKA ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Pocket Fit						
No	140.0	94.5%	48.6	90.9%	188.6	93.5%
Yes	1.2	.8%	4.9	9.1%	6.0	3.0%
Missing	7.0	4.7%	.0	.0%	7.0	3.5%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%

ECWCS PARKA ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	ECWCS PARKA ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
March in Place						
Not hindered	144.2	97.4%	47.3	88.4%	191.5	95.0%
Hindered	1.2	.8%	6.2	11.6%	7.4	3.7%
Missing	2.7	1.8%	.0	.0%	2.7	1.3%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Squat						
Not hindered	118.9	80.3%	35.6	66.7%	154.5	76.7%
Hindered	23.1	15.6%	17.8	33.3%	41.0	20.3%
Missing	6.1	4.1%	.0	.0%	6.1	3.0%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Bend at Waist						
Not hindered	129.4	87.4%	41.7	78.0%	171.1	84.9%
Hindered	14.8	10.0%	11.8	22.0%	26.6	13.2%
Missing	3.9	2.6%	.0	.0%	3.9	1.9%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Turn Head						
Not hindered	49.0	33.1%	22.7	42.4%	71.6	35.5%
Hindered	83.3	56.2%	29.0	54.2%	112.2	55.7%
Missing	15.9	10.7%	1.8	3.4%	17.7	8.8%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Reach Front						
Not hindered	143.6	96.9%	53.5	100.0%	197.0	97.7%
Hindered	.7	.5%	.0	.0%	.7	.3%
Missing	3.9	2.6%	.0	.0%	3.9	1.9%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Reach Side						
Not hindered	145.4	98.2%	53.5	100.0%	198.9	98.7%
Missing	2.7	1.8%	.0	.0%	2.7	1.3%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%
Reach Up						
Not hindered	144.7	97.7%	52.1	97.5%	196.8	97.6%
Hindered	.7	.5%	1.4	2.5%	2.0	1.0%
Missing	2.7	1.8%	.0	.0%	2.7	1.3%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%

(continued)

ECWCS PARKA ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	ECWCS PARKA ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Climb						
Not hindered	130.2	87.9%	42.0	78.5%	172.2	85.4%
Hindered	15.2	10.3%	11.5	21.5%	26.7	13.3%
Missing	2.7	1.8%	.0	.0%	2.7	1.3%
Group Total	148.1	100.0%	53.5	100.0%	201.6	100.0%

WET WEATHER TROUSER ACCEPTABILITY BY STATIC FIT VARIABLES

	WET WEATHER TROUSER ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Buttock Fit						
Satisfactory	150.1	88.1%	18.6	59.4%	168.7	83.7%
Tight	6.3	3.7%	4.2	13.5%	10.5	5.2%
Loose	9.8	5.8%	8.5	27.1%	18.3	9.1%
Missing	4.1	2.4%	.0	.0%	4.1	2.0%
Group Total	170.3	100.0%	31.3	100.0%	201.6	100.0%
Abdomen Fit						
Satisfactory	138.7	81.4%	13.8	44.2%	152.5	75.7%
Tight	5.9	3.5%	5.9	19.0%	11.9	5.9%
Loose	19.4	11.4%	11.5	36.8%	30.9	15.3%
Missing	6.3	3.7%	.0	.0%	6.3	3.1%
Group Total	170.3	100.0%	31.3	100.0%	201.6	100.0%
Waist Fit						
Satisfactory	164.4	96.5%	23.5	75.2%	187.9	93.2%
Tight	.7	.4%	2.9	9.1%	3.5	1.8%
Loose	1.2	.7%	3.7	11.9%	4.9	2.4%
Missing	4.1	2.4%	1.2	3.8%	5.3	2.6%
Group Total	170.3	100.0%	31.3	100.0%	201.6	100.0%
Crotch Fit						
Satisfactory	128.3	75.3%	14.7	47.0%	143.0	70.9%
More	37.9	22.3%	15.4	49.2%	53.3	26.5%
Missing	4.1	2.4%	1.2	3.8%	5.3	2.6%
Group Total	170.3	100.0%	31.3	100.0%	201.6	100.0%
Inseam Length						
No	163.2	95.8%	25.4	81.0%	188.6	93.5%
Yes	3.0	1.8%	5.3	16.8%	8.3	4.1%
Missing	4.1	2.4%	.7	2.2%	4.8	2.4%
Group Total	170.3	100.0%	31.3	100.0%	201.6	100.0%
Waist Cord Length						
No	141.0	82.8%	21.3	68.1%	162.3	80.5%
Yes	25.2	14.8%	8.8	28.1%	34.0	16.9%
Missing	4.1	2.4%	1.2	3.8%	5.3	2.6%
Group Total	170.3	100.0%	31.3	100.0%	201.6	100.0%

WET WEATHER TROUSER ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	WET WEATHER TROUSER ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
March in Place						
Not hindered	164.0	96.3%	16.9	54.0%	180.9	89.8%
Hindered	2.2	1.3%	14.4	46.0%	16.6	8.2%
Missing	4.1	2.4%	.0	.0%	4.1	2.0%
Group Total	170.3	100.0%	31.3	100.0%	201.6	100.0%
Squat						
Not hindered	152.3	89.4%	20.7	66.1%	173.0	85.8%
Hindered	8.8	5.2%	9.9	31.7%	18.8	9.3%
Missing	9.1	5.4%	.7	2.2%	9.8	4.9%
Group Total	170.3	100.0%	31.3	100.0%	201.6	100.0%
Climb						
Not hindered	155.2	91.1%	10.6	34.0%	165.9	82.3%
Hindered	11.0	6.5%	20.0	63.8%	31.0	15.4%
Missing	4.1	2.4%	.7	2.2%	4.8	2.4%
Group Total	170.3	100.0%	31.3	100.0%	201.6	100.0%

LIGHT DUTY WORK GLOVE ACCEPTABILITY BY STATIC FIT VARIABLES

	LIGHT DUTY WORK GLOVE ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Not Seated						
Satisfactory	110.5	61.2%	4.9	23.3%	115.4	57.2%
Crotch	67.4	37.3%	16.0	76.7%	83.5	41.4%
Missing	1.5	.9%			1.5	.8%
Idx/Crh	1.2	.6%			1.2	.6%
Group Total	180.7	100.0%	20.9	100.0%	201.6	100.0%
Fingers Extend >3/8"						
Satisfactory	135.2	74.8%	6.4	30.6%	141.6	70.2%
Thumb	1.5	.9%	.7	3.3%	2.2	1.1%
Index	5.6	3.1%	4.2	20.1%	9.8	4.9%
Fourth	1.8	1.0%	4.9	23.2%	6.7	3.3%
Third	2.9	1.6%	1.9	8.9%	4.8	2.4%
Thb/Idx	1.2	.6%			1.2	.6%
Thb/Third	2.3	1.3%			2.3	1.2%
Idx/Fourth	3.7	2.0%			3.7	1.8%
Idx/Third	16.5	9.2%	1.5	7.4%	18.1	9.0%
Third/Fourth	3.4	1.9%			3.4	1.7%
Thb/Udx/ Third	1.4	.8%			1.4	.7%
Idx/Third/ Fourth	3.7	2.0%	1.4	6.5%	5.1	2.5%
Thb/Idx/ Third/ Fourth	1.4	.8%			1.4	.7%
Group Total	180.7	100.0%	20.9	100.0%	201.6	100.0%
Fifth Finger >5/8"						
No	170.5	94.4%	13.5	64.5%	184.0	91.3%
Yes	10.1	5.6%	6.7	32.2%	16.9	8.4%
Missing			.7	3.3%	.7	.3%
Group Total	180.7	100.0%	20.9	100.0%	201.6	100.0%
Cortches Offset >3/8"						
No	178.8	99.0%	13.2	62.9%	192.0	95.2%
Yes	.7	.4%	7.8	37.1%	8.5	4.2%

(continued)

LIGHT DUTY WORK GLOVE ACCEPTABILITY BY STATIC FIT VARIABLES

	LIGHT DUTY WORK GLOVE ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Missing	1.2	.6%			1.2	.6%
Group Total	180.7	100.0%	20.9	100.0%	201.6	100.0%
Circumferen-tial Constriction						
No	177.3	98.2%	20.2	96.7%	197.6	98.0%
Yes	2.2	1.2%	.7	3.3%	2.9	1.4%
Missing	1.2	.6%			1.2	.6%
Group Total	180.7	100.0%	20.9	100.0%	201.6	100.0%
Excess Finger Circumference >1/2"						
No	179.5	99.4%	20.9	100.0%	200.4	99.4%
Missing	1.2	.6%			1.2	.6%
Group Total	180.7	100.0%	20.9	100.0%	201.6	100.0%
Excess Hand Circumferenc >1 5/8"						
No	179.5	100.0%	18.2	87.0%	197.7	98.6%
Yes			2.7	13.0%	2.7	1.4%
Group Total	179.5	100.0%	20.9	100.0%	200.4	100.0%

LIGHT DUTY WORK GLOVE ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	LIGHT DUTY WORK GLOVE ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Make Fist						
Not hindered	177.8	98.4%	17.2	82.2%	195.0	96.7%
Hindered	2.9	1.6%	2.5	12.1%	5.4	2.7%
Missing			1.2	5.6%	1.2	.6%
Group Total	180.7	100.0%	20.9	100.0%	201.6	100.0%
Flex Index Finger						
Not hindered	135.9	75.2%	10.8	51.6%	146.7	72.8%
Hindered	43.4	24.0%	10.1	48.4%	53.5	26.5%
Missing	1.4	.8%			1.4	.7%
Group Total	180.7	100.0%	20.9	100.0%	201.6	100.0%
Flex Wrist						
Not hindered	180.7	100.0%	20.9	100.0%	201.6	100.0%
Group Total	180.7	100.0%	20.9	100.0%	201.6	100.0%
Doff						
Not hindered	179.0	99.1%	20.9	100.0%	199.9	99.2%
Missing	1.7	.9%			1.7	.8%
Group Total	180.7	100.0%	20.9	100.0%	201.6	100.0%

PASGT HELMET ACCEPTABILITY BY STATIC FIT VARIABLES

	PASGT HELMET ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Helmet Visor Location						
No	186.4	99.0%	9.0	67.2%	195.4	96.9%
Yes			4.4	32.8%	4.4	2.2%
Missing	1.9	1.0%			1.9	.9%
Group Total	188.2	100.0%	13.4	100.0%	201.6	100.0%
Chin Strap Snugness						
No	186.4	99.0%	13.4	100.0%	199.7	99.1%
Missing	1.9	1.0%			1.9	.9%
Group Total	188.2	100.0%	13.4	100.0%	201.6	100.0%
Neckline Location						
No	186.4	99.0%	13.4	100.0%	199.7	99.1%
Missing	1.9	1.0%			1.9	.9%
Group Total	188.2	100.0%	13.4	100.0%	201.6	100.0%
Stability						
No	186.4	99.0%	6.7	50.4%	193.1	95.8%
Yes			6.6	49.6%	6.6	3.3%
Missing	1.9	1.0%			1.9	.9%
Group Total	188.2	100.0%	13.4	100.0%	201.6	100.0%

PASGT HELMET ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	PASGT HELMET ACCEPTABILITY				Group Total	
	ACCEPTABLE		UNACCEPTABLE		Count	Col %
	Count	Col %	Count	Col %		
Tilt Head Back						
Not hindered	177.4	94.3%	7.4	55.5%	184.8	91.7%
Hindered	9.0	4.8%	5.3	39.4%	14.2	7.1%
Missing	1.8	1.0%	.7	5.1%	2.5	1.3%
Group Total	188.2	100.0%	13.4	100.0%	201.6	100.0%
Tilt Head Down						
Not hindered	184.5	98.0%	6.2	46.7%	190.8	94.6%
Hindered	.7	.4%	7.1	53.3%	7.8	3.9%
Missing	3.0	1.6%			3.0	1.5%
Group Total	188.2	100.0%	13.4	100.0%	201.6	100.0%
Forward Vision-						
Not hindered	182.0	96.7%	9.2	68.6%	191.2	94.8%
Hindered	4.4	2.3%	2.4	17.6%	6.7	3.3%
Missing	1.9	1.0%	1.8	13.8%	3.7	1.8%
Group Total	188.2	100.0%	13.4	100.0%	201.6	100.0%

MC1-1 PARACHUTE HARNESS ACCEPTABILITY BY STATIC FIT VARIABLES

	PARACHUTE HARNESS ACCEPTABILITY						Group Total	
	UNACCEPTABLE		ACCEPTABLE		MISSING		Count	Col %
	Count	Col %	Count	Col %	Count	Col %		
Pack Top Location								
No			185.8	99.0%	8.4	63.4%	194.2	96.3%
Yes	.7	100.0%	1.9	1.0%			2.5	1.3%
Missing					4.8	36.6%	4.8	2.4%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Harness Slippage								
Satisfactory			182.3	97.1%	8.4	63.4%	190.7	94.6%
Horizontal	.7	100.0%	3.0	1.6%			3.7	1.8%
Both			1.2	.6%			1.2	.6%
Missing			1.2	.6%	4.8	36.6%	6.0	3.0%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Buckle Location								
No	.7	100.0%	187.7	100.0%	8.4	63.4%	196.7	97.6%
Missing					4.8	36.6%	4.8	2.4%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Pack Lower Location								
No			170.2	90.7%	8.4	63.4%	178.6	88.6%
Yes	.7	100.0%	16.8	9.0%			17.5	8.7%
Missing			.7	.4%	4.8	36.6%	5.5	2.7%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Saddle Location								
Satisfactory	.7	100.0%	185.3	98.8%	8.4	63.4%	194.4	96.4%
Above			1.2	.6%			1.2	.6%
Missing			1.2	.6%	4.8	36.6%	6.0	3.0%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Chest Strap Location								
Satisfactory			14.4	7.6%			14.4	7.1%
Above	.7	100.0%	104.3	55.6%			105.0	52.1%
Below			4.9	2.6%			4.9	2.4%
Centered			60.8	32.4%			60.8	30.2%
Missing			3.3	1.8%	13.2	100.0%	16.6	8.2%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%

MC1-1 PARACHUTE HARNESS ACCEPTABILITY BY FUNCTIONAL FIT VARIABLES

	PARACHUTE HARNESS ACCEPTABILITY						Group Total	
	UNACCEPT		ACCEPT		9		Count	Col %
	Count	Col %	Count	Col %	Count	Col %		
March in Place								
Not hindered	.7	100.0%	181.3	96.6%	8.4	63.4%	190.3	94.4%
Hindered			6.4	3.4%			6.4	3.2%
Missing					4.8	36.6%	4.8	2.4%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Squat								
Not hindered	.7	100.0%	186.5	99.4%	8.4	63.4%	195.6	97.0%
Hindered			1.2	.6%			1.2	.6%
Missing					4.8	36.6%	4.8	2.4%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Bend at Waist								
Not hindered	.7	100.0%	187.0	99.6%	8.4	63.4%	196.1	97.3%
Hindered			.7	.4%			.7	.3%
Missing					4.8	36.6%	4.8	2.4%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Turn Head								
Not hindered	.7	100.0%	186.3	99.3%	8.4	63.4%	195.4	96.9%
Hindered			1.4	.7%			1.4	.7%
Missing					4.8	36.6%	4.8	2.4%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Reach Front								
Not hindered	.7	100.0%	178.9	95.3%	8.4	63.4%	188.0	93.2%
Hindered			8.8	4.7%			8.8	4.4%
Missing				-	4.8	36.6%	4.8	2.4%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Reach Side								
Not hindered	.7	100.0%	187.0	99.6%	8.4	63.4%	196.1	97.3%
Hindered			.7	.4%			.7	.3%
Missing					4.8	36.6%	4.8	2.4%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%
Reach Up								
Not hindered	.7	100.0%	113.5	60.5%	2.5	19.1%	116.7	57.9%
Hindered			73.0	38.9%			73.0	36.2%
Missing			1.2	.6%	10.7	80.9%	11.9	5.9%
Group Total	.7	100.0%	187.7	100.0%	13.2	100.0%	201.6	100.0%

APPENDIX H
Results of Statistical Tests on Clothing/Individual Equipment

FISHER'S EXACT TESTS TO DETERMINE INDEPENDENCE OF WEIGHT-FOR HEIGHT STANDARD STATUS WITH ACCEPTABILTY

Clothing/Individual Equipment Item	Weight-for-Height		Best Fit Size	
	Fisher's F	Exact *p*	Fisher's F	Exact *p*
CW Trigger Finger Mitten	2.0190	0.1698	n/a	n/a
CVC Coverall	2.2117	0.1835	6.320	0.1714
Mechanics' Coverall	2.2217	0.1601	n/a	n/a
ALICE Pack	3.3360	0.0818	n/a	n/a
PASGT Vest	2.8265	0.1179	11.90	**0.0062***
Enhanced Tactical Load Bearing Ves	3.1930	0.0809	0.4572	0.5497
Wet Weather Trouser	6.2894	0.0181	3.210	0.4009
ECWCS Parka	0.7537	0.4285	7.7350	0.3311

CW Trigger Finger Mitten								
Anthropometric Variables	Fit	n	Mean	s.d.	Variance *F*	Variance *p*	Main Effects F	Main Effects *p*
Stature (mm)	Unaccept	194	1574.73	43.58				
	Accept	8	1615.93	39.49	1.22	.865	6.799	.010
Weight (kg)	Unaccept	194	59.88	8.44				
	Accept	8	66.94	9.46	1.26	.734	5.512	.020
Waist Circ NI (m	Unaccept	194	743.27	70.84				
	Accept	8	776.97	61.01	1.35	.734	1.949	.164
Chest Circ (mm)	Unaccept	194	919.31	68.07				
	Accept	8	951.07	77.77	1.31	.499	1.796	.182
Hand Circ	Unaccept	150	186.71	8.32				
	Accept	1	181.00	0.00	n/a	n/a	0.698	.405
Hand Length	Unaccept	153	172.83	8.57				
	Accept	2	176.50	0.66	169.3	.052	0.199	.657

^=Heterogenous Variance at p<.05

*=Significantly different at p<.05 using a Bonferroni Correction (p<.05/4=.0125)

Mechanics' Coverall								
Anthropometric Variables	Fit	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*
Stature (mm)	Unaccept	145	1569.93	45.47				
	Accept	57	1581.54	35.75	1.62	.041	11.074	**.001***
Weight (kg)	Unaccept	145	59.40	8.90				
	Accept	57	62.05	7.41	1.44	.119	5.487	.020
Waist Circ NI (m	Unaccept	145	740.17	70.56				
	Accept	57	755.73	70.27	1.01	.996	3.771	.054
Chest Circ (mm)	Unaccept	145	915.31	67.73				
	Accept	57	933.82	69.33	1.05	.809	4.500	.035

^=Heterogenous Variance at p<.05

*=Significantly different at p<.05 using a Bonferroni Correction (p<.05/4=.0125)

ALICE Frame and Large Pack												
Anthropometric Variables	Fit	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature (mm)	Unaccept	124	1569.58	47.30							
	Accept	78	1587.12	36.05	1.72	**.011^**			3530.5	9109.5	**.0023***
Weight (kg)	Unaccept	124	60.19	8.96							
	Accept	78	60.09	7.96	1.27	.259	0.049	.825			
Waist Circ NI (mm)	Unaccept	124	748.52	70.44							
	Accept	78	738.25	71.00	1.02	.927	0.938	.334			
Chest Circ (mm)	Unaccept	124	923.86	70.61							
	Accept	78	915.24	65.15	1.17	.448	1.005	.317			

^=Heterogenous Variance at p<.05

*=Significantly different at p<.05 using a Bonferroni Correction (p<.05/9=.0055)

PASGT Vest											
Anthropometric Variables	Fit	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature (mm)	Unaccept	87	1569.47	49.21							
	Accept	115	1581.53	39.14	1.58	**.022^**			4541.5	8111.5	.4721
Weight (kg)	Unaccept	87	60.54	9.36							
	Accept	115	59.85	7.94	1.39	.100	0.339	.561			
Waist Circ NI (mm)	Unaccept	87	751.92	71.81							
	Accept	115	738.99	69.56	1.07	.746	1.855	.175			
Chest Circ (mm)	Unaccept	87	927.39	73.43							
	Accept	115	915.34	64.40	1.30	.190	1.654	.200			

^=Heterogenous Variance at p<.05
*=Significantly different at p<.05 using a Bonferroni Correction (p<.05/9=.0055)

Enhanced Tactical Load Bearing Vest											
Anthropometric Variables	Fit	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*	Mann-Whitney *U* *U*	*W*	*p*
Stature (mm)	Unaccept	59	1558.62	49.99							
	Accept	143	1583.56	39.33	1.62	**.023^**			2959.5	444.5	**.0028***
Weight (kg)	Unaccept	59	60.40	8.63							
	Accept	143	60.05	8.57	1.01	.922	8.615	**.004***			
Waist Circ NI (mm)	Unaccept	59	759.36	72.87							
	Accept	143	738.52	69.08	1.11	.604	4.957	.027			
Chest Circ (mm)	Unaccept	59	941.55	75.04							
	Accept	143	911.95	63.99	1.38	.133	8.455	**.004***			

^=Heterogenous Variance at p<.05
*=Significantly different at p<.05 using a Bonferroni Correction (p<.05/9=.0055)

Wet Weather Trousers								
Anthropometric Variables	Fit	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*
Stature (mm)	Unaccept	170	1578.97	42.18				
	Accept	31	1562	51.55	1.49	.119	3.919	.049
Weight (kg)	Unaccept	170	60.61	8.47				
	Accept	31	57.68	8.80	1.08	.737	3.890	.050
Waist Circ NI (mm)	Unaccept	170	746.9	69.94				
	Accept	31	731.7	74.30	1.13	.615	2.152	.144
Chest Circ (mm)	Unaccept	170	922.4	67.66				
	Accept	31	910.6	73.42	1.18	.510	1.546	.215

^=Heterogeneous Variance (p<.05)
*=Significantly different at p<.05 using a Bonferroni Correction (p<.05/4=.0125)

ECWCS Parka								
Anthropometric Variables	Fit	n	Mean	s.d.	Variance *F*	*p*	Main Effects F	*p*
Stature (mm)	Unaccept	53	1579.06	45.81				
	Accept	148	1575.34	43.53	1.11	.627	0.347	.557
Weight (kg)	Unaccept	53	60.25	8.11				
	Accept	148	60.12	8.75	1.16	.534	0.095	.759
Waist Circ NI (m	Unaccept	53	744.60	63.89				
	Accept	148	744.56	73.15	1.31	.260	0.277	.600
Chest Circ (mm)	Unaccept	53	922.43	64.25				
	Accept	148	919.86	70.20	1.19	.465	0.049	.825

^=Heterogenous Variance at p<.05

*=Significantly different at p<.05 using a Bonferroni Correction (p<.05/4=.0125)