ANTHROPOMETRIC COMPARISONS BETWEEN BODY MEASUREMENTS OF MEN AND WOMEN (U)

EDWARD SCHAFER, Ph.D.
BARRY T. BATES, Ph.D.

BIO-DYNAMICS CORPORATION

JUNE 1988

FINAL REPORT FOR PERIOD JULY 1986 TO DECEMBER 1987

Approved for public release; distribution is unlimited.

HARRY G. ARMSTRONG AEROSPACE MEDICAL RESEARCH LABORATORY
HUMAN SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433-6573
NOTICES

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related Government procurement operation, the Government thereby incurs no responsibility nor any obligation whatsoever, and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Please do not request copies of this report from the Armstrong Aerospace Medical Research Laboratory. Additional copies may be purchased from:

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Federal Government agencies and their contractors registered with the Defense Technical Information Center should direct requests for copies of this report to:

Defense Technical Information Center
Cameron Station
Alexandria, Virginia 22314

TECHNICAL REVIEW AND APPROVAL

AAMRL-TR-88-020

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

CHARLES BATES, JR.
Director, Human Engineering Division
Armstrong Aerospace Medical Research Laboratory
Anthropometric Comparisons Between Body Measurements of Men and Women (U)

Schafer, Edward Ph.D. and Bates, Barry T. Ph.D.

Final report from Jul 86 to Dec 87 dated June 1988.
This study was carried out under contract F33615-86-C-J547 with the Harry G. Armstrong Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, Ohio. Project scientists were Dr. Edward Schafer and Dr. Barry T. Bates, Bio-Dynamics Corporation. Ms. Kathleen M. Robinette, Human Engineering Division, Harry G. Armstrong Aerospace Medical Research Laboratory was contract monitor.

Mr. Shinwon Kim assisted in the computer analysis and construction of tables. Mr. Richard H. Tromel edited the report and coordinated resources needed to complete the work.
TABLE OF CONTENTS

INTRODUCTION .................................................................................................................. 5

CHAPTER I. BACKGROUND ............................................................................................. 7

   Total Body Anthropometry ............................................................................................ 7
   Sex Related Anthropometry .......................................................................................... 11

CHAPTER II. PROCEDURES. ............................................................................................ 15

   Sample Description ....................................................................................................... 15
   Variable Description ..................................................................................................... 15
   Discriminant Analyses ................................................................................................. 15
   Regression Analyses ...................................................................................................... 18

CHAPTER III. RESULTS AND CONCLUSIONS ............................................................... .21

   Descriptive Statistics ................................................................................................... .21
   Discriminant Analysis ................................................................................................. .26
   Bivariate Distribution Plots. ....................................................................................... .35
   Regression Analysis ..................................................................................................... .42

REFERENCES .................................................................................................................... .54

APPENDIX A VARIABLE DESCRIPTIONS ....................................................................... .56

APPENDIX B REGRESSION EQUATIONS ......................................................................... .61

APPENDIX C ESTIMATED DIFFERENCES. ................................................................. .71
LIST OF FIGURES

Figure 1  Bivariate Distribution Plot of Weight by Stature for Males .................. 36
Figure 2  Bivariate Distribution Plot of Weight by Stature for Females ............... 37
Figure 3  Bivariate Distribution Plot of Shoulder Circumference by Stature for Males .......................................................... 38
Figure 4  Bivariate Distribution Plot of Shoulder Circumference by Stature for Females .......................................................... 39
Figure 5  Bivariate Distribution Plot of Shoulder Circumference by Hip Circumference for Males ................................................. 40
Figure 6  Bivariate Distribution Plot of Shoulder Circumference by Hip Circumference for Females ................................................. 41
Figure 7  Variable Descriptions used for Coverall/Flightsuit Analysis .................... 57

LIST OF TABLES

Table 1  Variables Used in Coverall/Flightsuit Analysis ........................................ 16
Table 2  Means and Standard Deviations Used in the Coverall/Flightsuit Analysis .......... 22
Table 3  Correlation Matrix of Variables Used in Coverall/Flightsuit Analysis, Male Sample .................................................. 23
Table 4  Correlation Matrix of Variables Used in Coverall/Flightsuit Analysis, Female Sample .................................................. 24
Table 5  Correlation Matrix of Variables Used in Coverall/Flightsuit Analysis, Total Sample .................................................. 25
Table 6  Discriminant Analysis of Selected Body Measures with Gender as the Dependent Variable and No Variables Forced into the model .......... 27
Table 7  Discriminant Analysis of Selected Body Measures with Gender as the Dependent Variable and Weight and Stature Forced into the model ........ 29
Table 8  Discriminant Analysis of Selected Body Measures with Gender as the Dependent Variable and Stature and Shoulder Circumference Forced into the model ..... 31
| Table 9 | Regression Analysis of Coverall/Flightsuit Measures using Stature and Weight as Independent Variables | .43 |
| Table 10 | Regression Analysis of Coverall/Flightsuit Measures using Stature and Shoulder Circumference as Independent Variables | .44 |
| Table 11 | Regression Coefficient of Sex-Shoulder Circumference as a Percent of the Regression Coefficient of Shoulder Circumference | .45 |
| Table 12 | Regression Analysis of Coverall/Flightsuit Measures using Shoulder and Hip Circumference as Independent Variables | .46 |
| Table 13 | Regression Coefficient of Sex-Hip Circumference as a Percent of the Regression Coefficient of Hip Circumference | .47 |
| Table 14 | Maximum and Minimum Differences Between Male and Female Estimated Values from Separate Regression Models | .52 |
| Table 15 | Regression Analysis of Coverall/Flightsuit Measures Using Stature and Weight as Independent Variables | .62 |
| Table 16 | Regression Analysis of Coverall/Flightsuit Measures Using Stature and Shoulder Circumference as Independent Variables | .65 |
| Table 17 | Regression Analysis of Coverall/Flightsuit Measures Using Hip and Shoulder Circumference as Independent Variables | .68 |
| Table 18 | Estimated Male minus Female Computed Values with Stature and Weight as Dependent Variables | .72 |
| Table 19 | Estimated Male minus Female Computed Values with Stature and Shoulder Circumference as Dependent Variables | .76 |
| Table 20 | Estimated Male minus Female Computed Values with Hip and Shoulder Circumference as Dependent Variables | .80 |
INTRODUCTION

With the increasing number of military occupation specialties open to female personnel, potential problems in the design and sizing of protective clothing and equipment have become apparent. These problems arise from the fact that most protective equipment and clothing now used by the armed forces were designed specifically for males. The improper fit of clothing and equipment can affect the safety, efficiency and productivity of personnel.

Recent studies (cf. McConville, Robinette and White; 1981) have documented the fact that anthropometric differences exist between genders which rule out the use of a "down-sized" male sizing system for females. The specific differences which preclude the "down-sizing" option are gender differences in proportionality among various body measurements.

Two possible solutions to the inadequacy of "down-sizing" male garments for use by females are:

1. Separate sizing system for females based upon observed female body measurements.

2. Single system that incorporates differences in body proportions based upon the values of a few key dimensions.

While the first option will likely produce garments with the best overall fit, the costs incurred in the production of two separate sets of garments which meet the same functional need are something to be avoided if possible. The second option offers a compromise between the inadequacy of a "down-sized" male system and the redundancy of a separate sizing system for each gender group. However, if such a system is to work, research must be conducted to identify where differences in proportionality occur, and which, if any, key body dimensions can vary with these observed differences.

Thus, the purpose of this study was to identify differences in the proportionality among body dimensions between sexes which could affect the design and development of an adequate sizing system. Specifically, this research report will focus on those body measurements that are known to be important in the design and sizing of coverall/flightsuit-type garments.
To better understand the differences in proportionality between genders, this research employed multiple discriminant analysis and multiple regression techniques. The discriminant analysis was used to identify key dimensions, i.e., body measures which appear to have the greatest proportional difference between sexes; while multiple regression was used to calibrate the relationships between selected key dimensions and other variables important to the proper fit of coverall/flightsuit-type garments.

Nineteen of the 20 variable means were statistically greater for the males with hip circumferences being equal. Practically all correlation coefficients (99.3%) were significantly different from zero with 28.9% having magnitudes equal to or greater than 0.71. The results were similar between data sets with generally high intercorrelations within the length measures and within the subset of circumference values and weight. Overall, the discriminant analyses indicated a considerable divergence from cross-gender proportionality. At least 14 variables entered each of the three models evaluated with five standardized coefficients being equal to or greater than 0.775. In addition, the signs of the coefficients were both positive (40%) and negative (60%) further indicating cross-gender disproportionality. The results of the regression analyses suggest that none of the three models were adequate for estimating the values of the independent variable nor effectively compensating for the general lack of cross-gender anthropometric proportionality. The two sets of models using stature as a predictor variable with weight and shoulder circumference produced a large number of models in which the estimated female values exceeded the corresponding male values indicating the inappropriateness of a "down-sized" male sizing system for females. The third model (hip and shoulder circumferences) partially alleviated this problem of disproportionality but the results still indicated a general lack of "goodness of fit".
CHAPTER I
BACKGROUND

This chapter contains a review of selected literature in order to provide the reader with background information. The review of anthropometric literature presented is divided into two anthropometric areas: a) total body and b) sex related. Since these areas are not mutually exclusive some reports are included in both sections.

Total Body Anthropometry

In the early part of this century, two extensive bibliographies were published which summarized the anthropometric literature available at that time. O'Brien, Peterson and Worner (1929) prepared a bibliography for the United States Department of Agriculture (USDA) on the relation of clothing to health. This bibliography contained references for studies of body measurements, anthropometrics and hygiene as they related to military and civilian clothing.

Shortly thereafter, O'Brien (1930) prepared an annotated list of literature references for the USDA on garment sizes and body measurements. The major finding of the report was that no scientifically determined measurements related to garment design had been published, with the exception of one study relative to uniform design. Basically, the only information available on the design of garments at that time was anthropometric information obtained from military records and physical development data gathered by physical educators. The report did provide a list of garment design-related literature for the following: children, adults, military, insurance companies and college students.

The studies by Gould (1930) and Jorgensen and Hatlestad (1940) provide examples of the early types of total body anthropometric information gathered by physical educators. Gould's article presents results from a study of southern female college student physiques based on recorded physical measurements of young college women from 1909 to 1928. The mean height of these women was found to be 63.34 inches, with the mean weight equal to 116.2 pounds. On the average, over three and a half years of college attendance, these subject gained an average of 0.30 inches in height and 0.90 pounds in weight. After comparing results to female students in northern colleges, it was found that both the height and weight of southern women was slightly less.
Jorgensen and Hatlestad (1940) obtained 28 overall body anthropometric measurements on 200 college men and 300 college men aged 18 to 20 years in an attempt to determine body build. Body build was defined as a width-depth-stature relationship within a person. The results presented no evidence to support the existence of distinct types or categories of body build in either males or females. Rather, there seemed to be a continuous distribution of body builds ranging from extreme lateral to extreme linear. Some indices were more useful than others. The indices which proved most valuable for men and women were: weight/height, chest girth/height and leg length/chest girth.

In an attempt to remedy the data inadequacies uncovered in earlier reports, O'Brien and her colleague Shelton (1941) conducted an extensive civilian survey involving the measurement of weight and 58 body dimensions used in garment and pattern construction on over 10,000 white women in the United States. A detailed statistical analysis of the results was conducted and presented to the USDA, Bureau of Home Economics. The intention was to discern key measurements critical to the design of women's garments. The results suggested that a stature (height) and weight combination would provide the best basis for classifying women's body types for the establishment of a standard system of garment and pattern sizes. The investigators also found that girth measurements had little relationship to vertical measurements. Finally, it was determined that the five measurements of weight, stature, bust, waist and hip circumference determine fairly completely the size and shape of a woman.

Thurstone (1946) used the multivariate statistical technique of factor analysis in an examination of 12 anthropometric measurements obtained from adult men. It was found that the correlations among the variables could be accounted for by a simple structure of four factors. Factor 1 was termed "head size" and was described by the measurements of head length, head breadth and head height. Factor 2, called "bone length", contained the variables of stature, sitting height, span and hand length. Factor 3, the "girth" factor, included shoulder breadth, hip breadth, chest breadth and chest depth. Factor 4 was titled "size of extremities" with the variables: stature, span, hand length and hand breadth loading on this factor.

A more recent report from the civilian literature summarizes a study by Hathaway and Foard (1960), again conducted for the USDA. It contains data on the height and weight of adults.
in the United States. The contents of this report are quite extensive, and include the following sections: average heights and weights related to age, average weights for age, data on men in military service, data from other countries compared to the United States and changes in the United States population between 1790 and 1950.

In addition to the studies on civilian populations, more extensive surveys have been conducted by the military. Several large scale studies have been periodically conducted to update the anthropometric data base (Churchill & Bernhardi, 1957; Hertzberg, Churchill, Dupertuis, White & Damon, 1963; Laubach, McConville, Churchill & White, 1977; McConville, Churchill, Churchill & White, 1977; Tebbetts, Churchill & McConville, 1977). The reports on the findings of these studies are primarily published as technical reports available upon request from the military. A large number of measurements have been taken in each of the studies.

A major problem with the anthropometric studies conducted through the late 1970's is the difficulty in consolidating the information from the various studies into usable form. An important advance was made to the study and use of the human anthropometric literature with the development of a data bank by the Aerospace Medical Research Laboratory (AMRL) (McConville, Churchill & Clauser, 1977). This data bank was established as a resource for designers, and incorporated raw data from most current large-scale anthropometric surveys in comparable format. Data from 30 large-scale anthropometric surveys representing a total sample of over 80,000 military and civilian men and women were consolidated.

McConville and Clauser (1978) provided a historical overview of collections of anthropometric data, as well as a listing of the current resources of the AMRL data bank. They suggested that segments of the population such as foreign women and ethnic subgroups in the United States are inadequately represented or missing from the data bank.

White (1978) prepared an excellent review and summary of the sources of anthropometric data in the United States military and civilian population of adults and children. He also provided a brief review of anthropometric data sources from various foreign counties. Human engineering factors and considerations are the primary topic of this literature summary. The lack of anthropometric data with regard to civilian populations was discussed as well as the shortcoming of using data from military populations as a basis for designing clothing and equipment for civilian populations. For example, the military population is, in general, a
young population, as well as a population with a smaller range of variation in body size and measurements. With respect to trends in human engineering, White suggested that one area with a strong need for applied anthropometry is in the design of clothing and apparel.

Some of the more recent military reports have attempted to address the need for applied anthropometry for the purpose of clothing design. Alexander and McConville (1979) discussed the series of height/weight sizing programs used by designers of protective clothing for United States Air Force (USAF) men. The original system of sizing was based on the 1950 sample of subjects who were 0.75 inches shorter and 10 pounds lighter on the average than the 1967 survey data used for the current sizing program. The 1967 sample was comprised of 2420 male officers on active flying status in the USAF, who were 98 percent white and ranged in age from 23 to 32 years. Excluding head, hand and foot measurements, 71 body dimensions were used. The report presents sizing tables for four, six, eight and twelve size programs alone with bivariate tables, summary statistics, percentile data and tariffs. The supporting text indicates that height and weight correlate well with many other body dimensions which are central to most design problems.

With regard to the choice of key sizing dimensions, the following decisions were made (Alexander & McConville, 1979). No single measurement was adequate for sizing garments because no single dimension is related closely to both lengths/heights and girths/breadths. Secondly, the designer should choose two or more key dimensions which need not correlate well with each other but should correlate well with other included measurements. For example, height and weight can be used as the key dimensions for the sizing of one piece flight garments. Finally, after the key dimensions are chosen, the designer must establish size intervals, dimensional data by size, design values and tariffs.

Robinette (1984) advocated a similar strategy for the design process. Development and use of anthropometric programs for the design of personal protective clothing and equipment were discussed and an anthropometric sizing system advocated as the basis for design via the following techniques. First, select one or two key dimensions. "Key" dimensions are described as those which collectively have a strong relationship with most of the other dimensions important to the item being designed. Second, divide the user sample into similar subgroups. Summarize the variability in the remaining dimensions and select design values for the key dimensions to accommodate the observed variance for each subgroup.
In summary, total body anthropometric data have been obtained primarily from military populations. Good data from civilian populations is relatively scarce. This is unfortunate since anthropometric data is foundational to the design of clothing, equipment and workspaces for both military and civilian population.

**Sex Related Anthropometry**

Much of the early work involving sex related anthropometry has been conducted on civilian populations. The previously described series of studies completed by O'Brien, as well as those by the early physical educators, included female populations in their investigations.

Other more recent work in the area of sexual dimorphism has been completed by physical anthropologists. De Villiers (1968) studied the skulls of South African Negroes. Significant sex differences were found. The results indicated that the male skull was larger in 46 out of the 51 dimensions measured. The sexual dimorphism of the skull of the South African Negro was found to be associated mainly with the mandible. Many cranial indices did not distinguish between males and females, but rather sexual differences were reflected in the mandibular indices. The most significant sex differences were: height of the mandibular ramus, breadth of the face, and, to a lesser degree, length and height of the cranial vault. Sex differences in the shape of the skull were found to be less pronounced, and reflective of the infantile characteristics of the female skull.

Factor analysis and discriminant function analysis were employed by Choi and Trotter (1975) in a study of race-sex differences among fetal skeletons. Twenty-one measurements on each of 115 American white and negro fetal skeletons were evaluated. The result indicated that the factor patterns of race-sex groups were similar. The discriminant analysis results showed that differences between the sexes were more marked than that between different races. The authors concluded that possible race and sex differences are less discernible among fetal skeletons than adult skeletons.

Bleibtreu and Taylor (1976) also used multivariate techniques (discriminant function analysis and canonical analysis) to categorize sexual dimorphism and racial groups. Boys and girls of four ethnic groups (N=637) were studied. Previous results in this area have indicated that the "best" metric predictors differ among ethnic groups of the same chronological age. The results of this study indicated that the most important sex discriminators for children were
limb joint diameters and dimensions of the head and face (except for the American Indians). Head and face measures were found to be the only important linear measurements.

In the sex related anthropometric literature on military populations in the United States, the investigation reported by Churchill and Bernhardi (1957) on Women's Air Force (WAF) basic trainees served as a supplement to an original report in 1952 on WAF trainees. Based on 61 body dimension measurements, 1830 correlation coefficient pairings were obtained. Regression equations were provided for estimating all other dimensions.

Laubach, McConville, Churchill and White (1977) reported information from the first anthropometric survey of United States Army females in 30 years, involving 128 measurements on body size dimensions, 9 measurements of static strength, and 14 workspace dimensions. The purpose of the study was: to obtain and develop statistical data on female static muscle strength. The ultimate goal was to aid in the design of clothing, protective equipment, and workspace and industrial equipment. The first report in the series described the methodology involved, including landmarks used and procedures involved. The total series of measurements was divided into five separate groups. First, the core series included all 1331 subjects and 69 conventional body size measurements. Each of the remaining four series included approximately one-fourth of the subjects. Subseries 1 included approximately 24 additional conventional measures and several skinfold measurements. Subseries 2 involved 14 workspace measurements, while subseries 3 included 31 head and face measurements. Subseries 4 involved 9 strength measurements.

Another report on the results from an anthropometric survey of Army men and women was provided by McConville, Churchill, Churchill and White (1977). This survey involved 1331 United States Army women and 287 men. Subseries A included measurements of length, breadth and circumference of the head, while subseries C included head and face measurements.

One of the purposes for these extensive surveys is for the design of clothing and equipment for military men and women. Robinette, Churchill and McConville (1979) attempted to document true differences in body size and proportions between USAF men and women in relation to current design or changes in design. The data base used was the 1977 Army survey (McConville, Churchill, Churchill & White, 1977) of females and males. Fifty-six measurements were compared and evaluated with regard to the investigation of two main
assumptions: 1) female body size can be represented by scaling down male body dimensions and 2) that males and females of approximately equal body weight and stature are approximately equal in all other proportions. The authors concluded that females cannot be represented accurately by scaling down male proportions and dimensions but that some height/weight samples indicate a degree of similarity between the sexes for selected dimensions. Among the dimensions which were the least comparable were those involving body tissue commonly associated with secondary sex characteristics (such as hip circumference, chest depth, and bicep circumference/flexed). Hand, foot and head dimensions were other subgroups that did not scale down satisfactorily for females or match the corresponding male values.

Alexander and McConville (1979) presented a series of height/weight sizing programs used by designers of protective clothing for USAF men. The sizing values were based on an analysis of 1967 survey data involving 71 dimensions, excluding head, hand and foot measurements. The authors stated that, for the purposes of a general sizing program, the significant proportional differences between the sexes cannot be reconciled by the assumption that females require simply smaller scaled sizes of the same garments worn by men.

The report prepared by McConville, Robinette and White (1981) documented research leading to the development of an integrated male/female sizing system incorporating the body size data of persons of both sexes and taking into account the areas of disproportionality between them. The concepts underlying the development of a sizing system are presented along with the problems. The actual sizing programs developed are presented in a format usable for designers and pattern makers in a separate report (Robinette, Churchill & Tebbetts, 1981).

The approach used in the study (McConville, Robinette & White, 1981) was to identify key sizing variables that exert some level of control on variations of body size and proportionality found between the sexes for dimensions critical to the fit and function of the clothing item being sized. Stature and shoulder circumference were identified as the basis for sizing upper body garments. Crotch height and hip circumference were established as key dimensions for lower body unisex sizing programs. A system of 20 sizes was selected as adequate for both upper and lower body clothing systems.

In summary, literature in the area of sex differences in anthropometric measurements indicates that significant differences do exist between the sexes. These differences must be
identified and used in the design of equipment, clothing and workspaces that are to be used by both men and women.
CHAPTER II
PROCEDURES

This chapter contains sample and variable descriptions along with a description of the primary procedures used in the data analysis.

Sample Description

The data for the analysis were acquired from the AFAMRL Anthropometric Data Bank Library: Volume IX, 1977 Survey of Army Women. The data were taken from the anthropometric survey on U.S. Army women conducted during the winter of 1976-77 at four Army bases under the U.S. Army Research and Development Command, Natick, Massachusetts. The results of this survey are reported in the Anthropometry of Women of the U.S. Army-1977 which was published in five reports identified in the bibliography. In addition to information on the anthropometric characteristics of Army female personnel, there is also comparative data on a small sample of U.S. Army male personnel. Only data for white subjects were used in the analysis resulting in 970 female and 191 male data sets. All variables are expressed in millimeters except for weight which is in pounds. Rather than convert weight to metric units, pounds were retained to be consistent with the original data set.

Variable Descriptions

Twenty body dimensions were included in the analysis. These particular dimensions were selected because of their importance in ensuring proper fit of coverall/flightsuit type garments. The variables are identified in Table 1 and defined in Appendix A. Four measures known to be important were not included due to their absence from the sample (radiale-sty lion length, acromion-radiale length, biacromial breadth and vertical trunk circumference).

Discriminant Analysis

Previous research has shown that when men and women are matched with regard to height and weight, the two most mismatched dimensions of body size are hip and shoulder circumference (Robinette, et al., 1979). Thus, if one desires to develop an integrated sizing system that adequately fits both genders, at the least, these two body dimensions must be
Table 1. Variables Used in Coverall/Flightsuit Analysis

<table>
<thead>
<tr>
<th></th>
<th>Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Weight</td>
</tr>
<tr>
<td>2</td>
<td>Stature</td>
</tr>
<tr>
<td>3</td>
<td>Axilla Height</td>
</tr>
<tr>
<td>4</td>
<td>Bustpoint Height</td>
</tr>
<tr>
<td>5</td>
<td>Waist Height</td>
</tr>
<tr>
<td>6</td>
<td>Buttock Height</td>
</tr>
<tr>
<td>7</td>
<td>Sleeve Inseam</td>
</tr>
<tr>
<td>8</td>
<td>Sleeve Outseam</td>
</tr>
<tr>
<td>9</td>
<td>Shoulder Circumference</td>
</tr>
<tr>
<td>10</td>
<td>Sitting Height</td>
</tr>
<tr>
<td>11</td>
<td>Knee Height, Sitting</td>
</tr>
<tr>
<td>12</td>
<td>Hip Circumference</td>
</tr>
<tr>
<td>13</td>
<td>Biceps Circumference, Flexed</td>
</tr>
<tr>
<td>14</td>
<td>Waist Circumference</td>
</tr>
<tr>
<td>15</td>
<td>Back Arc, Bust</td>
</tr>
<tr>
<td>16</td>
<td>Intercye Front</td>
</tr>
<tr>
<td>17</td>
<td>Bust Circumference</td>
</tr>
<tr>
<td>18</td>
<td>Ankle Circumference</td>
</tr>
<tr>
<td>19</td>
<td>Waist Back Length</td>
</tr>
<tr>
<td>20</td>
<td>Back Arc, Waist</td>
</tr>
</tbody>
</table>
successfully fit. In addition, one needs to determine if there are other variables important to the adequate fit of flightsuit/coverall-type garments which exhibit differential proportionality across genders. Multiple discriminant analysis was used to identify these variables.

Multiple discriminant analysis is a particular procedure that is part of the general linear model. In the two-group situation (for example, males and females), this procedure is equivalent to multiple regression with a discrete variable having two levels (Kerlinger and Pedhazur; 1973: 377). The general form of the model is:

\[ D_{ik} = d_{i1}z_{1k} + d_{i2}z_{2k} + \ldots + d_{ip}z_{pk} \]  

(EQ 1)

where \( D_{ik} \) is the score for the \( k \)-th individual on discriminant function \( i \), the \( d \)'s are the standardized discriminant coefficients and the \( z \)'s are the \( p \) independent variables in standard form. Given that there are only two groups of individual cases (males or females), there is only one discriminant function and Equation 1 reduces to the form:

\[ D_k = d_{11}z_{1k} + d_{22}z_{2k} + \ldots + d_{pp}z_{pk} \]  

(EQ 2)

Thus, the discriminant function, for the two-group condition is little more than an estimated regression equation, with the only difference being the adjustment of the data for the group and total sample centroids or means (Nie, et al., 1975: 443).

The following basic assumptions about the statistical nature of the data are important for discriminant analysis:

1. All variables are measured on an interval or ratio scale.

2. Data cases must be assignable into one of two or more mutually exclusive groups.

3. Discriminating variables cannot be linear combinations of one or more other discriminating variables used in the analysis.

4. Equality must exist between the population covariance matrices.
In this application of discriminant analysis, stepwise inclusion of variables was used to identify body measurements which demonstrate significant disproportionality across gender groups. In addition, the stepwise procedure provides insight as to the relative importance of each measurement compared to all other variables in the model with regard to cross-gender disproportionality. That is, variables which enter the model early are judged more disproportionate than those which enter the model late.

Three specific analyses were performed on the data set in this study. In the first analysis, the two independent variables of stature and weight were forced into the discriminant function first. After this initial step, all remaining variables were allowed to enter the model based upon a statistically significant \((p < 0.05)\) Mahalanobis Distance \((D^2)\). In the second analysis, stature and shoulder circumference were forced into the model prior to the stepwise inclusion of all other variables. The inclusion criteria used in the first application was also used in this application. In the third analysis no variables were forced into the model and all variables were allowed to enter based upon the Mahalanobis Distance criteria used in applications one and two.

Regression Analysis

After identifying the most important variables in defining the disproportionality between males and females, the next step was to determine how these variables relate to other variables which are known to be important for proper fit of flightsuit/coverall garments. This was accomplished using multiple regression analysis procedures to estimate three sets of regression equations. Stature and weight, stature and shoulder circumference and the two highest loading variables from the unforced discriminant analysis were used as the independent variable pairs. The dependent variable set for each of the three sets of regression equations consisted of all other variables used in the analysis.

The basic assumptions of multiple regression analysis are:

1. All variables are measures on an interval or ratio scale.
2. Relationships between the independent and dependent variables are linear.

3. Residuals are normally distributed with equal variances across the ranges of the independent variables.

4. Residuals are not correlated with the independent variables in the model.

5. Populations from which the samples are drawn are multivariate normal (Blalock, 1979: 386-389).

All regressions were estimated using two forms of the model. The first form is:

\[ Y = a + b_1X_1 + b_2X_2 \]  \hspace{1cm} (EQ 3)

where Y is the dependent variable, the X's are the independent variables and the b's are the estimated partial regression coefficients and the a value is the intercept. This form of the model was estimated separately for males and females. The second form of the model is:

\[ Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 \]  \hspace{1cm} (EQ 4)

where Y is the dependent variable, \( X_1 \) and \( X_2 \) are the independent variables, \( X_3 \) is a dichotomous discrete variable representing gender with males assigned the value of zero and females assigned the value of one. \( X_4 \) and \( X_5 \) are cross-product interaction terms between sex and \( X_1 \) and \( X_2 \), respectively.

While Equation 3 is a predictive model, Equation 4 provides the information necessary to understand in what ways the structural relationships among various body dimensions vary across genders. Equation 5 is Equation 4 rewritten with comparable terms grouped:

\[ Y = (a + b_3X_3) + (b_1X_1 + b_4X_4) + (b_2X_2 + b_5X_5) \]  \hspace{1cm} (EQ 5)

Given that \( X_3 \) can take the value of 0 or 1 and that \( X_4 \) and \( X_5 \) are the products of \( X_3 \) and \( X_1 \), and \( X_3 \) and \( X_2 \), respectively, when \( X_3 \) equals zero Equation 5 reduces to Equation 3 since all product terms of \( X_3 \) also becomes zero. Thus, the estimated values of \( b_3 \), \( b_4 \) and \( b_5 \) illustrate the differences between female and male estimated values of \( a \), \( b_1 \) and \( b_2 \).
respectively. Thus, a significant $b_3$ indicates that the intercepts are different across genders, even after the effects of the independent variables have been accounted for. However, a significant $b_4$ or $b_6$ implies a difference between the independent and dependent variables across sexes. It is these differences that are of primary importance in this research.

In estimating both Equations 3 and 4 all relevant independent variables were allowed to enter the models simultaneously. Only the lack of sufficient tolerance precludes a variable from entering the model. In this application, a minimum tolerance level of 0.10 was used.

Equation 3 provides information as to the likely impact that differences between the sexes will have on the design and sizing of properly fitting garments. Male and female results were generated for each dependent variable for the various combinations of independent variables by inputting data values common to both males and females. The output of the male equation was then compared to the outcome of the female equation.
CHAPTER III
RESULTS AND CONCLUSIONS

This chapter contains the results of the analyses and an assessment of the likely impact that the findings will have on the proper design and fit of coverall/flightsuit garments.

Descriptive Statistics

Table 2 contains the means and standard deviations for the total sample as well as for each gender group. All mean values for males are greater than the corresponding measures for females with 19 of the 20 values being statistically greater (p < 0.05). However, it is noteworthy that mean hip circumferences for both gender groups are virtually the same (957.3 versus 956.7mm), suggesting some lack of cross-gender proportionality.

Tables 3, 4 and 5 contain the zero-order correlation coefficients for the male, female and total samples, respectively. An examination of these data indicate the presence of considerable multicollinearity. In each of the tables there are 190 cells. The numbers of coefficients significantly (p < 0.05) different from zero are 186 (97.9%) for the males and all values for the female and total samples. Overall, 28.9% of the coefficients had magnitudes equal to or greater than 0.71 indicating at least 50% common variance. The general pattern is for the length measures (heights, inseam and outseam) to correlate highly with each other (100% ≥ 0.71), while circumference values (except for ankle) correlate highly with one another and with weight (91.1% ≥ 0.71).

The presence of multicollinearity within the two blocks of variables noted above (length and circumference) could impact the analysis. With excessive multicollinearity, one of the basic problems of a stepwise procedure is that the order of entry into the model can be unstable across samples which come from the same population (Kachigan, 1982: 228).

The final aspect of the data contained in Tables 3, 4 and 5 is the similarity of results noted between genders. This is important since an assumption of discriminant analysis is that the correlation between any two predictor variables must be similar within the respective populations (Kachigan, 1982: 219).
Table 2. Means and Standard Deviations of All Variables Used in the Coverall/Flightsuit Analysis

<table>
<thead>
<tr>
<th>Variables</th>
<th>Male Mean</th>
<th>Male Std Dev</th>
<th>Female Mean</th>
<th>Female Std Dev</th>
<th>t-value</th>
<th>Total Mean</th>
<th>Total Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>1561.03</td>
<td>252.76</td>
<td>1318.05</td>
<td>183.99</td>
<td>15.59*</td>
<td>1358.02</td>
<td>216.48</td>
</tr>
<tr>
<td>Stature</td>
<td>1742.81</td>
<td>70.90</td>
<td>1632.29</td>
<td>64.18</td>
<td>21.37*</td>
<td>1650.47</td>
<td>77.10</td>
</tr>
<tr>
<td>Axilla Height</td>
<td>1312.28</td>
<td>60.71</td>
<td>1233.21</td>
<td>55.16</td>
<td>17.80*</td>
<td>1246.22</td>
<td>63.29</td>
</tr>
<tr>
<td>Bustpoint Height</td>
<td>1271.87</td>
<td>58.00</td>
<td>1182.27</td>
<td>55.48</td>
<td>20.25*</td>
<td>1197.01</td>
<td>65.01</td>
</tr>
<tr>
<td>Waist Height</td>
<td>1037.61</td>
<td>59.23</td>
<td>1013.49</td>
<td>50.74</td>
<td>5.83*</td>
<td>1017.46</td>
<td>52.97</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>886.19</td>
<td>49.85</td>
<td>831.79</td>
<td>44.01</td>
<td>15.27*</td>
<td>840.74</td>
<td>49.32</td>
</tr>
<tr>
<td>Sleeve Inseam</td>
<td>478.77</td>
<td>26.73</td>
<td>446.75</td>
<td>24.39</td>
<td>24.79*</td>
<td>452.02</td>
<td>27.48</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>584.10</td>
<td>32.32</td>
<td>534.43</td>
<td>28.17</td>
<td>21.72*</td>
<td>542.60</td>
<td>34.25</td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1107.14</td>
<td>63.71</td>
<td>1001.24</td>
<td>52.06</td>
<td>24.71*</td>
<td>1018.67</td>
<td>66.87</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>902.69</td>
<td>33.77</td>
<td>858.81</td>
<td>32.58</td>
<td>16.82*</td>
<td>866.03</td>
<td>36.58</td>
</tr>
<tr>
<td>Knee Height, Sitting</td>
<td>547.21</td>
<td>30.02</td>
<td>507.52</td>
<td>25.02</td>
<td>19.35*</td>
<td>514.05</td>
<td>29.79</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>957.30</td>
<td>63.74</td>
<td>956.67</td>
<td>61.27</td>
<td>0.13</td>
<td>956.77</td>
<td>61.66</td>
</tr>
<tr>
<td>Biceps Circumference, Flexed</td>
<td>310.30</td>
<td>27.62</td>
<td>267.59</td>
<td>22.44</td>
<td>23.37*</td>
<td>274.62</td>
<td>28.22</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>800.39</td>
<td>84.89</td>
<td>707.95</td>
<td>67.11</td>
<td>16.60*</td>
<td>723.16</td>
<td>78.22</td>
</tr>
<tr>
<td>Back Arc. Bust</td>
<td>455.66</td>
<td>34.72</td>
<td>420.39</td>
<td>30.62</td>
<td>31.33*</td>
<td>426.19</td>
<td>33.94</td>
</tr>
<tr>
<td>Intercye Front</td>
<td>364.95</td>
<td>19.61</td>
<td>330.82</td>
<td>17.09</td>
<td>24.60*</td>
<td>336.43</td>
<td>21.62</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>933.78</td>
<td>68.23</td>
<td>882.96</td>
<td>62.23</td>
<td>10.15*</td>
<td>891.32</td>
<td>65.97</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>217.51</td>
<td>14.44</td>
<td>208.21</td>
<td>12.32</td>
<td>9.25*</td>
<td>209.74</td>
<td>13.15</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>455.67</td>
<td>31.65</td>
<td>410.49</td>
<td>26.04</td>
<td>21.10*</td>
<td>417.92</td>
<td>31.81</td>
</tr>
<tr>
<td>Back Arc. Waist</td>
<td>396.90</td>
<td>44.66</td>
<td>352.98</td>
<td>33.76</td>
<td>15.51*</td>
<td>360.21</td>
<td>39.29</td>
</tr>
</tbody>
</table>

N = 191  N = 970  N = 1161

* p < 0.05

Note: All measures are in millimeters except weight which is in tenths of pound.
Table 3. Correlation Matrix of Variables Used In Coverall/Flightsuit Analysis, Male Sample

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weight</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Stature</td>
<td>0.54</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Axilla Height</td>
<td>0.49</td>
<td>0.97</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Bustpoint Height</td>
<td>0.46</td>
<td>0.96</td>
<td>0.97</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Waist Height</td>
<td>0.32</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Buttock Height</td>
<td>0.43</td>
<td>0.90</td>
<td>0.90</td>
<td>0.90</td>
<td>0.87</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Sleeve Inseam</td>
<td>0.34</td>
<td>0.80</td>
<td>0.80</td>
<td>0.81</td>
<td>0.79</td>
<td>0.79</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Sleeve Cutseam</td>
<td>0.47</td>
<td>0.81</td>
<td>0.82</td>
<td>0.81</td>
<td>0.78</td>
<td>0.79</td>
<td>0.92</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Shoulder Circumference</td>
<td>0.86</td>
<td>0.34</td>
<td>0.28</td>
<td>0.27</td>
<td>0.17</td>
<td>0.24</td>
<td>0.23</td>
<td>0.34</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Sitting Height</td>
<td>0.48</td>
<td>0.77</td>
<td>0.69</td>
<td>0.67</td>
<td>0.51</td>
<td>0.56</td>
<td>0.47</td>
<td>0.49</td>
<td>0.32</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Knee Height, Sitting</td>
<td>0.57</td>
<td>0.89</td>
<td>0.89</td>
<td>0.89</td>
<td>0.82</td>
<td>0.84</td>
<td>0.80</td>
<td>0.82</td>
<td>0.37</td>
<td>0.51</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Hip Circumference</td>
<td>0.94</td>
<td>0.44</td>
<td>0.41</td>
<td>0.37</td>
<td>0.27</td>
<td>0.34</td>
<td>0.29</td>
<td>0.43</td>
<td>0.82</td>
<td>0.40</td>
<td>0.50</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Biceps Circumference, Flexed</td>
<td>0.82</td>
<td>0.21</td>
<td>0.14</td>
<td>0.12</td>
<td>0.00</td>
<td>0.12</td>
<td>0.03</td>
<td>0.16</td>
<td>0.83</td>
<td>0.24</td>
<td>0.24</td>
<td>0.77</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Waist Circumference</td>
<td>0.91</td>
<td>0.32</td>
<td>0.29</td>
<td>0.24</td>
<td>0.11</td>
<td>0.24</td>
<td>0.18</td>
<td>0.32</td>
<td>0.77</td>
<td>0.27</td>
<td>0.39</td>
<td>0.90</td>
<td>0.77</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Back Arc, Bust</td>
<td>0.83</td>
<td>0.29</td>
<td>0.25</td>
<td>0.22</td>
<td>0.08</td>
<td>0.21</td>
<td>0.19</td>
<td>0.30</td>
<td>0.83</td>
<td>0.27</td>
<td>0.33</td>
<td>0.79</td>
<td>0.77</td>
<td>0.79</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Intercyte Front</td>
<td>0.67</td>
<td>0.43</td>
<td>0.41</td>
<td>0.39</td>
<td>0.29</td>
<td>0.37</td>
<td>0.28</td>
<td>0.36</td>
<td>0.70</td>
<td>0.38</td>
<td>0.44</td>
<td>0.63</td>
<td>0.53</td>
<td>0.54</td>
<td>0.53</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Bust Circumference</td>
<td>0.85</td>
<td>0.29</td>
<td>0.25</td>
<td>0.23</td>
<td>0.10</td>
<td>0.20</td>
<td>0.18</td>
<td>0.31</td>
<td>0.90</td>
<td>0.27</td>
<td>0.35</td>
<td>0.86</td>
<td>0.85</td>
<td>0.86</td>
<td>0.89</td>
<td>0.65</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Ankle Circumference</td>
<td>0.82</td>
<td>0.50</td>
<td>0.46</td>
<td>0.44</td>
<td>0.30</td>
<td>0.40</td>
<td>0.32</td>
<td>0.42</td>
<td>0.67</td>
<td>0.40</td>
<td>0.58</td>
<td>0.75</td>
<td>0.64</td>
<td>0.69</td>
<td>0.63</td>
<td>0.55</td>
<td>0.69</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Waist Back Length</td>
<td>0.52</td>
<td>0.51</td>
<td>0.48</td>
<td>0.43</td>
<td>0.18</td>
<td>0.32</td>
<td>0.31</td>
<td>0.35</td>
<td>0.37</td>
<td>0.57</td>
<td>0.41</td>
<td>0.48</td>
<td>0.36</td>
<td>0.45</td>
<td>0.38</td>
<td>0.35</td>
<td>0.37</td>
<td>0.44</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>20. Back Arc, Waist</td>
<td>0.87</td>
<td>0.30</td>
<td>0.27</td>
<td>0.22</td>
<td>0.09</td>
<td>0.24</td>
<td>0.16</td>
<td>0.30</td>
<td>0.73</td>
<td>0.24</td>
<td>0.38</td>
<td>0.86</td>
<td>0.75</td>
<td>0.78</td>
<td>0.50</td>
<td>0.82</td>
<td>0.67</td>
<td>0.43</td>
<td>1.00</td>
<td></td>
</tr>
</tbody>
</table>

Note: Critical r value with p < 0.05 equals 0.14
Table 4. Correlation Matrix of Variables Used In Coverall/Flightsuit Analysis, Female Sample

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weight</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Stature</td>
<td>0.54</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Axilla Height</td>
<td>0.53</td>
<td>0.97</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Bustpoint Height</td>
<td>0.47</td>
<td>0.90</td>
<td>0.95</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Waist Height</td>
<td>0.45</td>
<td>0.90</td>
<td>0.90</td>
<td>0.88</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Buttock Height</td>
<td>0.52</td>
<td>0.87</td>
<td>0.89</td>
<td>0.87</td>
<td>0.86</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Sleeve Inseam</td>
<td>0.36</td>
<td>0.79</td>
<td>0.79</td>
<td>0.78</td>
<td>0.79</td>
<td>0.80</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Sleeve Outseam</td>
<td>0.43</td>
<td>0.81</td>
<td>0.80</td>
<td>0.80</td>
<td>0.79</td>
<td>0.79</td>
<td>0.88</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Shoulder Circumference</td>
<td>0.82</td>
<td>0.34</td>
<td>0.32</td>
<td>0.28</td>
<td>0.27</td>
<td>0.35</td>
<td>0.23</td>
<td>0.29</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Sitting Height</td>
<td>0.47</td>
<td>0.81</td>
<td>0.75</td>
<td>0.71</td>
<td>0.64</td>
<td>0.54</td>
<td>0.49</td>
<td>0.53</td>
<td>0.29</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Knee Height, Sitting</td>
<td>0.56</td>
<td>0.86</td>
<td>0.87</td>
<td>0.86</td>
<td>0.87</td>
<td>0.79</td>
<td>0.82</td>
<td>0.37</td>
<td>0.57</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Hip Circumference</td>
<td>0.90</td>
<td>0.42</td>
<td>0.41</td>
<td>0.35</td>
<td>0.34</td>
<td>0.39</td>
<td>0.25</td>
<td>0.31</td>
<td>0.70</td>
<td>0.39</td>
<td>0.42</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Biceps Circumference, Flexed</td>
<td>0.82</td>
<td>0.21</td>
<td>0.20</td>
<td>0.17</td>
<td>0.14</td>
<td>0.22</td>
<td>0.05</td>
<td>0.13</td>
<td>0.78</td>
<td>0.21</td>
<td>0.25</td>
<td>0.73</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Waist Circumference</td>
<td>0.79</td>
<td>0.22</td>
<td>0.24</td>
<td>0.17</td>
<td>0.07</td>
<td>0.27</td>
<td>0.12</td>
<td>0.17</td>
<td>0.74</td>
<td>0.16</td>
<td>0.26</td>
<td>0.69</td>
<td>0.70</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Back Arc, Bust</td>
<td>0.75</td>
<td>0.22</td>
<td>0.23</td>
<td>0.17</td>
<td>0.17</td>
<td>0.26</td>
<td>0.14</td>
<td>0.20</td>
<td>0.77</td>
<td>0.16</td>
<td>0.27</td>
<td>0.64</td>
<td>0.66</td>
<td>0.73</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Intercy Front</td>
<td>0.55</td>
<td>0.40</td>
<td>0.36</td>
<td>0.35</td>
<td>0.33</td>
<td>0.36</td>
<td>0.30</td>
<td>0.35</td>
<td>0.61</td>
<td>0.33</td>
<td>0.41</td>
<td>0.47</td>
<td>0.40</td>
<td>0.40</td>
<td>0.40</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Bust Circumference</td>
<td>0.81</td>
<td>0.25</td>
<td>0.25</td>
<td>0.18</td>
<td>0.19</td>
<td>0.28</td>
<td>0.14</td>
<td>0.21</td>
<td>0.83</td>
<td>0.20</td>
<td>0.29</td>
<td>0.70</td>
<td>0.73</td>
<td>0.79</td>
<td>0.85</td>
<td>0.50</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Ankle Circumference</td>
<td>0.63</td>
<td>0.37</td>
<td>0.35</td>
<td>0.32</td>
<td>0.32</td>
<td>0.24</td>
<td>0.27</td>
<td>0.43</td>
<td>0.35</td>
<td>0.40</td>
<td>0.54</td>
<td>0.52</td>
<td>0.35</td>
<td>0.38</td>
<td>0.31</td>
<td>0.37</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Waist Back Length</td>
<td>0.31</td>
<td>0.52</td>
<td>0.49</td>
<td>0.44</td>
<td>0.29</td>
<td>0.36</td>
<td>0.34</td>
<td>0.35</td>
<td>0.18</td>
<td>0.54</td>
<td>0.37</td>
<td>0.22</td>
<td>0.15</td>
<td>0.31</td>
<td>0.14</td>
<td>0.18</td>
<td>0.13</td>
<td>0.20</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>20. Back Arc, Waist</td>
<td>0.76</td>
<td>0.20</td>
<td>0.21</td>
<td>0.15</td>
<td>0.07</td>
<td>0.25</td>
<td>0.11</td>
<td>0.16</td>
<td>0.72</td>
<td>0.14</td>
<td>0.24</td>
<td>0.67</td>
<td>0.68</td>
<td>0.94</td>
<td>0.75</td>
<td>0.38</td>
<td>0.77</td>
<td>0.34</td>
<td>0.30</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note: Critical r value with p < 0.05 equals 0.06
## Table 5. Correlation Matrix of Variables Used In Coverall/Flightsuit Analysis, Total Sample

<table>
<thead>
<tr>
<th>Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weight</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Stature</td>
<td>0.63</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Axilla Height</td>
<td>0.61</td>
<td>0.97</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Bustpoint Height</td>
<td>0.57</td>
<td>0.95</td>
<td>0.96</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Waist Height</td>
<td>0.44</td>
<td>0.83</td>
<td>0.86</td>
<td>0.83</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Buttock Height</td>
<td>0.58</td>
<td>0.89</td>
<td>0.91</td>
<td>0.90</td>
<td>0.85</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Sleeve Inseam</td>
<td>0.46</td>
<td>0.83</td>
<td>0.83</td>
<td>0.83</td>
<td>0.77</td>
<td>0.84</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Sleeve Outseam</td>
<td>0.55</td>
<td>0.86</td>
<td>0.85</td>
<td>0.85</td>
<td>0.75</td>
<td>0.83</td>
<td>0.91</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Shoulder Circumference</td>
<td>0.85</td>
<td>0.54</td>
<td>0.49</td>
<td>0.49</td>
<td>0.29</td>
<td>0.48</td>
<td>0.42</td>
<td>0.52</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Sitting Height</td>
<td>0.56</td>
<td>0.84</td>
<td>0.79</td>
<td>0.77</td>
<td>0.61</td>
<td>0.63</td>
<td>0.58</td>
<td>0.63</td>
<td>0.48</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Knee Height, Sitting</td>
<td>0.64</td>
<td>0.91</td>
<td>0.90</td>
<td>0.89</td>
<td>0.81</td>
<td>0.89</td>
<td>0.83</td>
<td>0.87</td>
<td>0.55</td>
<td>0.65</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Hip Circumference</td>
<td>0.82</td>
<td>0.55</td>
<td>0.56</td>
<td>0.36</td>
<td>0.34</td>
<td>0.20</td>
<td>0.37</td>
<td>0.29</td>
<td>0.37</td>
<td>0.81</td>
<td>0.32</td>
<td>0.41</td>
<td>0.62</td>
<td>0.74</td>
<td>0.78</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Biceps Circumference, Flexed</td>
<td>0.85</td>
<td>0.44</td>
<td>0.40</td>
<td>0.40</td>
<td>0.18</td>
<td>0.38</td>
<td>0.27</td>
<td>0.39</td>
<td>0.86</td>
<td>0.40</td>
<td>0.45</td>
<td>0.61</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Waist Circumference</td>
<td>0.85</td>
<td>0.42</td>
<td>0.40</td>
<td>0.37</td>
<td>0.15</td>
<td>0.39</td>
<td>0.30</td>
<td>0.39</td>
<td>0.85</td>
<td>0.40</td>
<td>0.44</td>
<td>0.66</td>
<td>0.78</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15. Back Arc, Bust</td>
<td>0.80</td>
<td>0.39</td>
<td>0.37</td>
<td>0.34</td>
<td>0.20</td>
<td>0.37</td>
<td>0.29</td>
<td>0.37</td>
<td>0.81</td>
<td>0.32</td>
<td>0.41</td>
<td>0.62</td>
<td>0.74</td>
<td>0.78</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16. Intercye Front</td>
<td>0.57</td>
<td>0.59</td>
<td>0.54</td>
<td>0.55</td>
<td>0.36</td>
<td>0.50</td>
<td>0.47</td>
<td>0.55</td>
<td>0.75</td>
<td>0.51</td>
<td>0.58</td>
<td>0.41</td>
<td>0.62</td>
<td>0.57</td>
<td>0.56</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. Bust Circumference</td>
<td>0.84</td>
<td>0.36</td>
<td>0.35</td>
<td>0.30</td>
<td>0.21</td>
<td>0.35</td>
<td>0.25</td>
<td>0.34</td>
<td>0.82</td>
<td>0.31</td>
<td>0.39</td>
<td>0.70</td>
<td>0.76</td>
<td>0.82</td>
<td>0.87</td>
<td>0.58</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Ankle Circumference</td>
<td>0.70</td>
<td>0.46</td>
<td>0.44</td>
<td>0.42</td>
<td>0.34</td>
<td>0.34</td>
<td>0.33</td>
<td>0.38</td>
<td>0.53</td>
<td>0.43</td>
<td>0.50</td>
<td>0.56</td>
<td>0.58</td>
<td>0.48</td>
<td>0.49</td>
<td>0.44</td>
<td>0.48</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Waist Back Length</td>
<td>0.49</td>
<td>0.65</td>
<td>0.61</td>
<td>0.59</td>
<td>0.31</td>
<td>0.48</td>
<td>0.48</td>
<td>0.53</td>
<td>0.46</td>
<td>0.65</td>
<td>0.54</td>
<td>0.23</td>
<td>0.43</td>
<td>0.49</td>
<td>0.35</td>
<td>0.45</td>
<td>0.30</td>
<td>0.34</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>20. Back Arc, Waist</td>
<td>0.82</td>
<td>0.39</td>
<td>0.37</td>
<td>0.34</td>
<td>0.14</td>
<td>0.37</td>
<td>0.28</td>
<td>0.37</td>
<td>0.77</td>
<td>0.31</td>
<td>0.42</td>
<td>0.64</td>
<td>0.76</td>
<td>0.95</td>
<td>0.79</td>
<td>0.54</td>
<td>0.80</td>
<td>0.47</td>
<td>0.48</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note: Critical r value with p < 0.05 equals 0.06
Discriminant Analyses

Tables 6, 7 and 8 contain the results of the discriminant analyses for the model with no forced variables, the model in which weight and stature are the forced variables and the model in which shoulder circumference and stature are the forced variables, respectively. Each table is divided into two panels. The top panel contains the step in which each variable entered the model, the standardized discriminant coefficient for each variable that met the criteria for entering the model, the overall canonical correlation coefficient and the proportion of correctly classified cases for the model. The second part of the table contains the structural coefficients for each variable indicating its relationship with the estimated discriminant function.

The step entered indicates the relative discriminating strength of each variable after adjusting for all variables that have been previously entered into the model. For example, the results in Table 6 demonstrate that, as a single variable, shoulder circumference has the greatest discriminating strength of all the variables used in the analysis. In addition, once differences in shoulder circumference have been accounted for, hip circumference contributes the next greatest degree of discriminating strength. This process is repeated until all variables meeting the criteria for inclusion in the model are entered.

The standardized discriminant coefficients reflect the relative strength and the direction of the effect of each variable in the model after all variables meeting the inclusion criteria have entered. Thus, while shoulder circumference has the greatest discriminating power by itself, when combined with the other variables in the model it is only the sixth most influential measure. When all variables were entered into the model, stature became the most influential variable.

The sign of the standardized discriminant coefficient indicates which genders values are relatively larger and which are relatively smaller for the respective body dimensions. For example, while males are relatively taller and have relatively greater shoulder circumferences than females, females have proportionately greater waist heights as well as hip and bust circumferences.
Table 6. Discriminant Analysis of Selected Body Measures  
With Gender as the Dependent Variable and No Variables  
Forced into the Model

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Step Entered</th>
<th>Standardized Discriminant Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stature</td>
<td>3</td>
<td>1.749</td>
</tr>
<tr>
<td>Waist Height</td>
<td>4</td>
<td>-1.183</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>2</td>
<td>-0.972</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>7</td>
<td>-0.783</td>
</tr>
<tr>
<td>Biceps Circumference, Flexed</td>
<td>5</td>
<td>0.778</td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1</td>
<td>0.490</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>6</td>
<td>0.386</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>11</td>
<td>-0.286</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>9</td>
<td>-0.271</td>
</tr>
<tr>
<td>Interscye Front</td>
<td>8</td>
<td>0.261</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>10</td>
<td>0.242</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>14</td>
<td>0.207</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>13</td>
<td>-0.143</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>12</td>
<td>-0.106</td>
</tr>
</tbody>
</table>

Number of Males = 191  
Number of Females = 970

Canonical Correlation = 0.87

Proportion Correctly Classified by Function

Males = 99.0%  
Females = 99.2%
<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Structural Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder Circumference</td>
<td>0.404</td>
</tr>
<tr>
<td>Interscye Front</td>
<td>0.402</td>
</tr>
<tr>
<td>Biceps Circumference, Flexed</td>
<td>0.377</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>0.355</td>
</tr>
<tr>
<td>Stature</td>
<td>0.349</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>0.345</td>
</tr>
<tr>
<td>Bustpoint Height</td>
<td>0.314</td>
</tr>
<tr>
<td>Knee Height, Sitting</td>
<td>0.302</td>
</tr>
<tr>
<td>Axilla Height</td>
<td>0.297</td>
</tr>
<tr>
<td>Sleeve Inseam</td>
<td>0.279</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>0.276</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>0.271</td>
</tr>
<tr>
<td>Back Arc, Waist</td>
<td>0.258</td>
</tr>
<tr>
<td>Weight</td>
<td>0.257</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>0.249</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>0.232</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>0.166</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>0.151</td>
</tr>
<tr>
<td>Waist Height</td>
<td>0.095</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>0.002</td>
</tr>
</tbody>
</table>
Table 7. Discriminant Analysis of Selected Body Measures With Gender as the Dependent Variable and Weight and Stature Forced into the Model

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Step Entered</th>
<th>Standardized Discriminant Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stature</td>
<td>1</td>
<td>1.760</td>
</tr>
<tr>
<td>Waist Height</td>
<td>4</td>
<td>-1.179</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>3</td>
<td>-0.952</td>
</tr>
<tr>
<td>Biceps Circumference, Flexed</td>
<td>5</td>
<td>0.790</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>9</td>
<td>-0.775</td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>8</td>
<td>0.492</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>6</td>
<td>0.386</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>12</td>
<td>-0.287</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>10</td>
<td>-0.269</td>
</tr>
<tr>
<td>Interscye Front</td>
<td>7</td>
<td>0.262</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>11</td>
<td>0.245</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>15</td>
<td>0.221</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>14</td>
<td>-0.144</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>13</td>
<td>-0.098</td>
</tr>
<tr>
<td>Weight</td>
<td>2</td>
<td>-0.066</td>
</tr>
</tbody>
</table>

Number of Males = 191
Number of Females = 970

Canonical Correlation = 0.87

Proportion Correctly Classified by Function

Males = 99.0%
Females = 99.2%
Table 7. Continued

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Structural Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder Circumference</td>
<td>0.404</td>
</tr>
<tr>
<td>Interscye Front</td>
<td>0.402</td>
</tr>
<tr>
<td>Biceps Circumference, Flexed</td>
<td>0.377</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>0.355</td>
</tr>
<tr>
<td>Stature</td>
<td>0.349</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>0.345</td>
</tr>
<tr>
<td>Bustpoint Height</td>
<td>0.314</td>
</tr>
<tr>
<td>Knee Height, Sitting</td>
<td>0.301</td>
</tr>
<tr>
<td>Axilla Height</td>
<td>0.297</td>
</tr>
<tr>
<td>Sleeve Inseam</td>
<td>0.279</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>0.276</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>0.271</td>
</tr>
<tr>
<td>Back Arc, Waist</td>
<td>0.258</td>
</tr>
<tr>
<td>Weight</td>
<td>0.255</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>0.249</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>0.232</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>0.166</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>0.151</td>
</tr>
<tr>
<td>Waist Height</td>
<td>0.095</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>0.002</td>
</tr>
</tbody>
</table>
Table 8. Discriminant Analysis of Selected Body Measures
With Gender as the Dependent Variable and Stature
and Shoulder Circumference Forced into the Model

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Step Entered</th>
<th>Standardized Discriminant Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stature</td>
<td>2</td>
<td>1.749</td>
</tr>
<tr>
<td>Waist Height</td>
<td>4</td>
<td>-1.183</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>3</td>
<td>-0.972</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>7</td>
<td>-0.783</td>
</tr>
<tr>
<td>Biceps Circumference, Flexed</td>
<td>5</td>
<td>0.778</td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1</td>
<td>0.490</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>6</td>
<td>0.386</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>11</td>
<td>-0.286</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>9</td>
<td>-0.271</td>
</tr>
<tr>
<td>Interscye Front</td>
<td>8</td>
<td>0.261</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>10</td>
<td>0.242</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>14</td>
<td>0.207</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>13</td>
<td>-0.143</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>12</td>
<td>-0.106</td>
</tr>
</tbody>
</table>

Number of Males = 191
Number of Females = 970

Canonical Correlation = 0.87

Proportion Correctly Classified by Function

Males = 99.0%
Females = 99.2%
<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Structural Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder Circumference</td>
<td>0.404</td>
</tr>
<tr>
<td>Interscye Front</td>
<td>0.402</td>
</tr>
<tr>
<td>Biceps Circumference, Flexed</td>
<td>0.377</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>0.355</td>
</tr>
<tr>
<td>Stature</td>
<td>0.349</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>0.345</td>
</tr>
<tr>
<td>Bustpoint Height</td>
<td>0.314</td>
</tr>
<tr>
<td>Knee Height, Sitting</td>
<td>0.302</td>
</tr>
<tr>
<td>Axilla Height</td>
<td>0.297</td>
</tr>
<tr>
<td>Sleeve Inseam</td>
<td>0.279</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>0.276</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>0.271</td>
</tr>
<tr>
<td>Back Arc, Waist</td>
<td>0.258</td>
</tr>
<tr>
<td>Weight</td>
<td>0.257</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>0.249</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>0.232</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>0.166</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>0.151</td>
</tr>
<tr>
<td>Waist Height</td>
<td>0.095</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>0.002</td>
</tr>
</tbody>
</table>
The canonical correlation coefficient and the proportion correctly classified are measures of the adequacy of the overall discriminant function. As previously noted, when applying discriminant analysis to a two group situation, the procedure becomes analogous to multiple regression with a dichotomous dependent variable. The canonical correlation coefficient, in this case, is nothing more than the multiple regression correlation coefficient.

The proportion correctly classified by the function indicates the percent of all cases in the sample that would have been correctly classified by gender from the function if the actual sexes of the cases were unknown. Obviously, this has little practical application in this study other than as a measure of the power of the function.

The model with no forced variables (Table 6) is the one to which the others are compared. The first four variables to enter the model were shoulder circumference, hip circumference, stature and waist height. In all, 14 variables met the criteria for entry. A noteworthy exception was weight. The probable reason is that the first four variables are measures of circumference and stature which are very important dimensions of weight as evidenced by their linear relationship with weight (Tables 3-5). Overall, the model appears to have excellent discriminating power. Approximately 99 percent of all cases were correctly classified. In addition, the canonical correlation coefficient was 0.87.

Once all variables were entered in the model, the strength of shoulder circumference diminished to sixth place with a standardized discriminant coefficient of 0.490. By comparison, stature, the most important variable in the completed model, has a coefficient of 1.749.

With regard to the sign associated with each variable's standardized discriminant coefficient, women appear to have proportionately greater height measurements (waist, buttock and sitting heights) than males, with the exception of overall stature. Furthermore, the magnitude of the disproportionality is significant. For instance, the coefficient for waist height has the second greatest magnitude of all coefficients (-1.183). In addition to the height measures, females have proportionately larger hip, bust and ankle circumferences (-0.972, -0.783 and -0.106, respectively), as well as greater waist back length (-0.143).

In terms of designing flightsuits and coverall clothing, the lack of inter-gender proportionality between stature and waist height and hip and shoulder circumferences could
be important. For example, the results contained in Table 8 suggest that a flight suit designed for a male but worn by a woman of the same height would be too large at the shoulders yet too small at the hips and chest/bust regions. In addition, the waist band would ride too low on the woman's torso.

A review of the structural coefficients in Table 6 indicates that the estimated discriminant function is not highly correlated with any particular variable. The greatest coefficient is 0.404. Thus, less than 20% of the total variance of the discriminant scores is shared by any one variable. Yet as previously noted in the analysis of the zero-order correlation coefficients, there appear to be two dimensions of the body to which a number of variables contribute: length and circumference. A review of the structural coefficients suggests that the estimated discriminant function is some linear combination of these two dimensions with the upper body circumferences being most dominant (shoulder circumference and interscye front) followed by various aspects of body length. Of note is the fact that the two variables most weakly associated with the estimated function are hip circumference and waist height, while shoulder circumference and stature are both moderately associated with the function (0.404 and 0.349, respectively). These relative differences in structural coefficients provide additional support to the earlier suggestion that the two major dimensions of inter-gender disproportionality are differences in proportionality between stature and waist height and between shoulder and hip circumference.

Table 7 contains the results of the discriminant analysis where weight and stature were forced into the model as the first two independent variables. A comparison of these data with the Table 6 results reveals little difference between the two. The two minor differences which do occur are the presence of one additional variable in the model (weight) and a change in the relative strength between two explanatory variables, bust circumference and bicep circumference. With weight forced into the model, the relative strength of bust circumference declines slightly. This is most likely the result of the high correlation between weight and this variable. No discernable differences between the performances of the two models were observed. That is, both have canonical correlation coefficients of 0.87 and the proportion correctly classified by the estimated functions is identical (99.1%). Finally, a comparison of the structural coefficients between the two models indicates a virtual correspondence in the mathematical structure of the two estimated discriminant functions. This is evident by the fact that the structural coefficients (the zero-order
correlations coefficients between each independent variable and the estimated factor scores) are identical across the two models.

Table 8 contains the results of the analysis in which the independent variables of stature and shoulder circumference were initially forced into the model. Other than the step entered, the results of Table 8 are identical to those contained in Table 6 and very similar to the results of Table 7.

Overall, the results of the discriminant analyses indicate a considerable divergence from cross-gender anthropometric proportionality. For example, if there was perfect proportionality, only one variable would ever enter the discriminant function since all other variables would be mathematical transformations of that one variable. However, in these models, at least 14 variables entered, with five of the 14 having standardized discriminant coefficients of 0.775 or greater. In addition, the signs associated with each coefficient indicate the direction of the disproportionality. For example, after controlling for stature, women are likely to have a greater waist height and greater hip and bust circumferences while men are likely to have greater shoulder and biceps circumferences.

Bivariate Distribution Plots

Figures 1 through 6 contain gender-specific bivariate distribution plots for 1) weight by stature, 2) shoulder circumference by stature and 3) shoulder circumference by hip circumference. Each plot indicates the location of the male or female sub-samples across the two selected variables. In addition, those subjects incorrectly classified by the function are indicated with an "X".

A cross-gender comparison of the distribution of cases within each bivariate plot conforms to what one would expect given the proportional differences of the four variables used in the plots. That is, for stature, weight and shoulder circumference, the male cases tend to cluster at the larger end of the distribution, while the female cases are concentrated at the smaller end. Hip circumference values are more similar with nearly identical mean values and females exhibiting the largest values.

Due to the relatively small number of male cases in the sample and the fact that few cases were incorrectly classified, caution is warranted in drawing conclusions about differences
Figure 1. Bivariate Distribution Plot of Weight by Stature for Males

<table>
<thead>
<tr>
<th>Stature (millimeters)</th>
<th>1500</th>
<th>1525</th>
<th>1550</th>
<th>1575</th>
<th>1600</th>
<th>1625</th>
<th>1650</th>
<th>1675</th>
<th>1700</th>
<th>1725</th>
<th>1750</th>
<th>1775</th>
<th>1800</th>
</tr>
</thead>
<tbody>
<tr>
<td>105</td>
<td>1X</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td>4X</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>125</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>130</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>145</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>155</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>165</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>170</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>175</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>180</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Each "X" represents one incorrectly classified case.
Figure 2. Bivariate Distribution Plot of Weight by Stature for Females

<table>
<thead>
<tr>
<th>Stature (millimeters)</th>
<th>1500</th>
<th>1525</th>
<th>1550</th>
<th>1575</th>
<th>1600</th>
<th>1625</th>
<th>1650</th>
<th>1675</th>
<th>1700</th>
<th>1725</th>
<th>1750</th>
<th>1775</th>
<th>1800</th>
</tr>
</thead>
<tbody>
<tr>
<td>105</td>
<td>1</td>
<td>2</td>
<td>7</td>
<td>3</td>
<td>11</td>
<td>7</td>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>1</td>
<td>2</td>
<td>9</td>
<td>15</td>
<td>13</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>115</td>
<td>4</td>
<td>4</td>
<td>14</td>
<td>14</td>
<td>8</td>
<td>12</td>
<td>12</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>11</td>
<td>19</td>
<td>21</td>
<td>11</td>
<td>7</td>
<td>3X</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>125</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td>11</td>
<td>16</td>
<td>19</td>
<td>12</td>
<td>17</td>
<td>9</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>130</td>
<td>7</td>
<td>9</td>
<td>20</td>
<td>19</td>
<td>17</td>
<td>18</td>
<td>10</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>135</td>
<td>2</td>
<td>5</td>
<td>15</td>
<td>18</td>
<td>17</td>
<td>21</td>
<td>13</td>
<td>9</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>140</td>
<td>3</td>
<td>4</td>
<td>7</td>
<td>18</td>
<td>10</td>
<td>13</td>
<td>7X</td>
<td>4</td>
<td>7</td>
<td>3X</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>145</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>12</td>
<td>17</td>
<td>11</td>
<td>6</td>
<td>7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>150</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>9</td>
<td>11X</td>
<td>5</td>
<td>10</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>155</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>5</td>
<td>8X</td>
<td>5</td>
<td>2</td>
<td>1X</td>
<td>1X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>165</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>170</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>175</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>4</td>
<td>3X</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Each "X" represents one incorrectly classified case.
Figure 3. Bivariate Distribution Plot of Shoulder Circumference by Stature for Males

<table>
<thead>
<tr>
<th>Stature (millimeters)</th>
<th>1500</th>
<th>1525</th>
<th>1550</th>
<th>1575</th>
<th>1600</th>
<th>1625</th>
<th>1650</th>
<th>1675</th>
<th>1700</th>
<th>1725</th>
<th>1750</th>
<th>1775</th>
<th>1800</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>925</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>950</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>975</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1025</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1050</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1075</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1125</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Each "x" represents one incorrectly classified case.
Figure 4. Bivariate Distribution Plot of Shoulder Circumference by Stature for Females

<table>
<thead>
<tr>
<th>Stature (millimeters)</th>
<th>1500</th>
<th>1525</th>
<th>1550</th>
<th>1575</th>
<th>1600</th>
<th>1625</th>
<th>1650</th>
<th>1675</th>
<th>1700</th>
<th>1725</th>
<th>1750</th>
<th>1775</th>
<th>1800</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>925</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>11</td>
<td>4</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>950</td>
<td>4</td>
<td>45</td>
<td>11</td>
<td>17</td>
<td>17</td>
<td>17</td>
<td>6</td>
<td>11</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>975</td>
<td>3</td>
<td>3</td>
<td>11</td>
<td>20</td>
<td>27</td>
<td>26</td>
<td>24</td>
<td>18</td>
<td>15</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1000</td>
<td>2</td>
<td>5</td>
<td>15</td>
<td>16</td>
<td>20</td>
<td>30</td>
<td>19</td>
<td>27</td>
<td>13</td>
<td>12X</td>
<td>7</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>1025</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>11</td>
<td>23</td>
<td>37</td>
<td>28</td>
<td>37</td>
<td>17</td>
<td>12</td>
<td>8</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1050</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>5</td>
<td>21</td>
<td>10</td>
<td>20</td>
<td>23</td>
<td>11</td>
<td>15</td>
<td>15</td>
<td>6X</td>
<td>1</td>
</tr>
<tr>
<td>1075</td>
<td>4</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>12</td>
<td>13</td>
<td>8X</td>
<td>8X</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1125</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>4X</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1X</td>
<td></td>
</tr>
<tr>
<td>1150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1X</td>
</tr>
</tbody>
</table>

Note: Each "X" represents one incorrectly classified case.
Figure 5. Bivariate Distribution Plot of Shoulder Circumference by Hip Circumference for Males

<table>
<thead>
<tr>
<th>Hip Circumference (millimeters)</th>
<th>875</th>
<th>900</th>
<th>925</th>
<th>950</th>
<th>975</th>
<th>1000</th>
<th>1025</th>
<th>1050</th>
<th>1075</th>
<th>1100</th>
<th>1125</th>
<th>1150</th>
<th>1175</th>
</tr>
</thead>
<tbody>
<tr>
<td>900</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>925</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>950</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>975</td>
<td>1X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>4X</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1025</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1050</td>
<td>2</td>
<td>5</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1075</td>
<td>1</td>
<td>5</td>
<td>13</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td>7</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1125</td>
<td>3</td>
<td>7</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1150</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>8</td>
<td>4</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>1</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>9</td>
<td>6</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Each "X" represents one incorrectly classified case.
Figure 6. Bivariate Distribution Plot of Shoulder Circumference by Hip Circumference for Females

<table>
<thead>
<tr>
<th>Hip Circumference (millimeters)</th>
<th>875</th>
<th>900</th>
<th>925</th>
<th>950</th>
<th>975</th>
<th>1000</th>
<th>1025</th>
<th>1050</th>
<th>1075</th>
<th>1100</th>
<th>1125</th>
<th>1150</th>
<th>1175</th>
</tr>
</thead>
<tbody>
<tr>
<td>875</td>
<td>16</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>900</td>
<td></td>
<td></td>
<td></td>
<td>17</td>
<td>11</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>925</td>
<td>19</td>
<td>34</td>
<td>20</td>
<td>21</td>
<td>7</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>950</td>
<td>18</td>
<td>22</td>
<td>45</td>
<td>34</td>
<td>23</td>
<td>6</td>
<td>6</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>975</td>
<td>7</td>
<td>16</td>
<td>32X</td>
<td>39</td>
<td>34</td>
<td>23</td>
<td>16</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>1</td>
<td>3</td>
<td>19</td>
<td>31</td>
<td>54</td>
<td>38</td>
<td>22</td>
<td>13</td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1025</td>
<td></td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>17X</td>
<td>36</td>
<td>35</td>
<td>18</td>
<td>14</td>
<td>2</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1050</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>13</td>
<td>19X</td>
<td>14X</td>
<td>10</td>
<td>6</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1075</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>8</td>
<td>11</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1100</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>6XX</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1125</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1X</td>
</tr>
</tbody>
</table>

Note: Each "X" represents one incorrectly classified case.
between the distributions of incorrectly classified cases across genders. However, if conclusions are reached, it appears that the incorrectly classified males represent more extreme cases than do the incorrectly classified females. This is evident by the fact that the misclassified females are located more within the overall female distribution than are the misclassified males. Furthermore, this relationship is consistent across the three sets of plots. Overall, only 2 (1.0%) of the 190 males and 8 (0.8%) of the 970 females were misclassified.

**Regression Analyses**

Thus far the analyses have illustrated a pronounced statistical deviation from anthropometric proportionality across genders. In addition, those variables most responsible for that lack of proportionality have been identified, i.e., stature, waist height, shoulder circumference and hip circumference. However, to provide the designer with information that can be used to improve the design and fit of coverall/flightsuit garments, more detail regarding the anthropometric differences between males and females must be documented. To obtain this necessary detail, regression analyses were employed. The results of these analyses are presented in Tables 9 through 13.

Tables 9, 10 and 12 contain the results of the regression analyses which estimate the relationships between the three different sets of two independent variables (stature and weight, stature and shoulder circumference, and shoulder circumference and hip circumference) and all other variables used in the analysis. In addition to the above sets of independent measures, the dummy variable sex (with males coded zero and females coded one) was also used in the estimations as were the cross-product interactions between sex and each of the two independent measures. The dummy variable sex and the two cross-product interactions were included in the analyses to provide insight as to the nature of the lack of proportionality. While significant estimated coefficients for the cross-product interactions indicate a lack of proportionality, a significant coefficient for the variable sex does not. Instead, a significant coefficient for sex only implies that the two genders differ with regard to the intercept even after controlling for the two independent measures. A complete listing of all male and female regression equations for all models is given in Tables 15-17, Appendix B.
Table 9. Regression Analysis of Overall/Flightsuit Measures using Stature and Weight as Independent Variables

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>STATURE</th>
<th>WEIGHT</th>
<th>SEX</th>
<th>SEX-STATURE</th>
<th>SEX-WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Axilla Height</td>
<td>0.954</td>
<td>8082.03 *</td>
<td>D</td>
<td>-0.002</td>
<td>-0.86</td>
<td>12.927</td>
</tr>
<tr>
<td>Bustpoint Height</td>
<td>0.923</td>
<td>4630.14 *</td>
<td>D</td>
<td>-0.018</td>
<td>-5.54 *</td>
<td>-1.336</td>
</tr>
<tr>
<td>Waist Height</td>
<td>0.813</td>
<td>1585.37 *</td>
<td>D</td>
<td>-0.025</td>
<td>-8.22 *</td>
<td>53.433</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>0.812</td>
<td>1872.83 *</td>
<td>D</td>
<td>0.007</td>
<td>1.75</td>
<td>13.030</td>
</tr>
<tr>
<td>Sleeve Inseam</td>
<td>0.705</td>
<td>923.62 *</td>
<td>D</td>
<td>0.014</td>
<td>5.35 *</td>
<td>0.347</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>0.763</td>
<td>1243.00 *</td>
<td>D</td>
<td>-0.002</td>
<td>-0.52</td>
<td>1.769</td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>0.809</td>
<td>1640.61 *</td>
<td>D</td>
<td>0.252</td>
<td>48.52 *</td>
<td>-16.782</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>0.721</td>
<td>1000.82 *</td>
<td>D</td>
<td>0.007</td>
<td>2.02 *</td>
<td>1.328</td>
</tr>
<tr>
<td>Knee Height, Sitting</td>
<td>0.842</td>
<td>2054.52 *</td>
<td>D</td>
<td>0.015</td>
<td>7.03</td>
<td>-0.013</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>0.832</td>
<td>1797.68 *</td>
<td>D</td>
<td>0.299</td>
<td>64.85 *</td>
<td>62.337</td>
</tr>
<tr>
<td>Biceps Circ., Flexed</td>
<td>0.830</td>
<td>1895.05 *</td>
<td>D</td>
<td>0.119</td>
<td>57.55 *</td>
<td>-26.803</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>0.777</td>
<td>1350.80 *</td>
<td>D</td>
<td>0.346</td>
<td>52.83 *</td>
<td>-41.359</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>0.685</td>
<td>842.71 *</td>
<td>D</td>
<td>0.143</td>
<td>42.42 *</td>
<td>-13.627</td>
</tr>
<tr>
<td>Intercoc Front</td>
<td>0.572</td>
<td>517.25 *</td>
<td>D</td>
<td>0.045</td>
<td>17.94 *</td>
<td>-19.146</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>0.754</td>
<td>1188.33 *</td>
<td>D</td>
<td>0.311</td>
<td>53.61</td>
<td>-3.108</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>0.492</td>
<td>375.68 *</td>
<td>D</td>
<td>0.042</td>
<td>24.97 *</td>
<td>1.944</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>0.478</td>
<td>355.11 *</td>
<td>D</td>
<td>0.015</td>
<td>3.67</td>
<td>-20.437</td>
</tr>
<tr>
<td>Back Arc, Waist</td>
<td>0.737</td>
<td>1083.56 *</td>
<td>D</td>
<td>0.172</td>
<td>47.96 *</td>
<td>-19.356</td>
</tr>
</tbody>
</table>

* p < 0.05
D: did not enter model due to insufficient tolerance
Table 10. Regression Analysis of Coverall/Flightsuit Measures using Stature and Shoulder Circumference as Independent Variables

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>STATURE</th>
<th>SHOULDER CIRCUMFERENCE</th>
<th>SEX</th>
<th>SEX-STATURE</th>
<th>SEX-SHOULDER CIRCUMFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>0.806</td>
<td>1605.58*</td>
<td>0.872</td>
<td>19.11*</td>
<td>2.560</td>
<td>48.69*</td>
</tr>
<tr>
<td>Axilla Height</td>
<td>0.955</td>
<td>8141.57*</td>
<td>0.839</td>
<td>130.13*</td>
<td>-0.027</td>
<td>-3.66*</td>
</tr>
<tr>
<td>Bustpoint Height</td>
<td>0.922</td>
<td>4601.47*</td>
<td>0.824</td>
<td>95.07*</td>
<td>-0.048</td>
<td>-4.85*</td>
</tr>
<tr>
<td>Waist Height</td>
<td>0.812</td>
<td>1657.64*</td>
<td>0.734</td>
<td>66.73*</td>
<td>-0.099</td>
<td>-7.83*</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>0.813</td>
<td>1682.57*</td>
<td>0.599</td>
<td>58.66*</td>
<td>0.019</td>
<td>1.68</td>
</tr>
<tr>
<td>Sleeve Inseam</td>
<td>0.699</td>
<td>897.89*</td>
<td>0.307</td>
<td>42.48*</td>
<td>-0.020</td>
<td>-2.40*</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>0.763</td>
<td>1248.25*</td>
<td>0.357</td>
<td>44.76*</td>
<td>0.019</td>
<td>2.06</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>0.721</td>
<td>999.02*</td>
<td>0.400</td>
<td>43.23*</td>
<td>0.016</td>
<td>1.53</td>
</tr>
<tr>
<td>Knee Height, Sitting</td>
<td>0.839</td>
<td>2011.01*</td>
<td>0.340</td>
<td>59.40*</td>
<td>0.035</td>
<td>5.35</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>0.567</td>
<td>507.68*</td>
<td>0.185</td>
<td>9.55*</td>
<td>0.684</td>
<td>30.59*</td>
</tr>
<tr>
<td>Biceps Circ., Flexed</td>
<td>0.749</td>
<td>1153.49*</td>
<td>0.023</td>
<td>-3.44*</td>
<td>0.350</td>
<td>45.89*</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>0.642</td>
<td>695.76*</td>
<td>0.011</td>
<td>-0.49*</td>
<td>0.967</td>
<td>37.54*</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>0.677</td>
<td>810.21*</td>
<td>0.017</td>
<td>-1.80*</td>
<td>0.454</td>
<td>42.89*</td>
</tr>
<tr>
<td>Intercye Front</td>
<td>0.632</td>
<td>664.75*</td>
<td>0.059</td>
<td>9.41*</td>
<td>0.186</td>
<td>25.70*</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>0.739</td>
<td>1094.22*</td>
<td>0.264</td>
<td>-1.76*</td>
<td>0.963</td>
<td>51.80*</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>0.346</td>
<td>205.12*</td>
<td>0.051</td>
<td>10.11*</td>
<td>0.088</td>
<td>14.97*</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>0.476</td>
<td>351.89*</td>
<td>0.207</td>
<td>18.76*</td>
<td>0.042</td>
<td>3.27</td>
</tr>
<tr>
<td>Back Arc, Waist</td>
<td>0.608</td>
<td>601.20*</td>
<td>0.013</td>
<td>-1.10*</td>
<td>0.480</td>
<td>35.44*</td>
</tr>
</tbody>
</table>

* p < 0.05
D : did not enter model due to insufficient tolerance
<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>SHOULDER CIRCUMFERENCE</th>
<th>SEX-SHOULDER CIRCUMFERENCE</th>
<th>SEX-SHOULDER CIRCUMFERENCE AS A PERCENT OF SHOULDER CIRCUMFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>2.560</td>
<td>48.69 *</td>
<td>0.122</td>
</tr>
<tr>
<td>Axilla Height</td>
<td>-0.027</td>
<td>-3.68 *</td>
<td>0.011</td>
</tr>
<tr>
<td>Bustpoint Height</td>
<td>-0.048</td>
<td>-4.85 *</td>
<td>-0.004</td>
</tr>
<tr>
<td>Waist Height</td>
<td>-0.099</td>
<td>-7.83 *</td>
<td>0.047</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>0.019</td>
<td>1.66</td>
<td>0.140</td>
</tr>
<tr>
<td>Sleeve Inseam</td>
<td>-0.020</td>
<td>2.40 *</td>
<td>-0.000</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>0.019</td>
<td>2.06 *</td>
<td>-0.008</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>0.016</td>
<td>1.53</td>
<td>0.002</td>
</tr>
<tr>
<td>Knee Height, Sitting</td>
<td>0.035</td>
<td>5.35 *</td>
<td>0.002</td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>0.684</td>
<td>30.59 *</td>
<td>0.092</td>
</tr>
<tr>
<td>Biceps Circ., Flexed</td>
<td>0.358</td>
<td>45.89 *</td>
<td>-0.007</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>0.967</td>
<td>37.54 *</td>
<td>0.009</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>0.454</td>
<td>42.69 *</td>
<td>0.011</td>
</tr>
<tr>
<td>Interscye Front</td>
<td>0.186</td>
<td>25.70 *</td>
<td>-0.008</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>0.963</td>
<td>51.80 *</td>
<td>0.048</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>0.088</td>
<td>14.97 *</td>
<td>0.005</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>0.042</td>
<td>3.27 *</td>
<td>-0.018</td>
</tr>
<tr>
<td>Back Arc, Waist</td>
<td>0.480</td>
<td>35.44 *</td>
<td>0.005</td>
</tr>
</tbody>
</table>

* p < 0.05
### Table 12: Regression Analysis of Overall/Flightsuit Measures using Shoulder and Hip Circumference as Independent Variables

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>SHOULDER CIRCUMFERENCE</th>
<th>HIP CIRCUMFERENCE</th>
<th>SEX</th>
<th>SEX-SHOULDER CIRCUMFERENCE</th>
<th>SEX-HIP CIRCUMFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>0.903</td>
<td>3581.94 *</td>
<td>1.299</td>
<td>23.98 *</td>
<td>2.027</td>
<td>41.77 *</td>
</tr>
<tr>
<td>Axilla Height</td>
<td>0.346</td>
<td>205.86 *</td>
<td>0.031</td>
<td>0.75</td>
<td>0.352</td>
<td>10.81 *</td>
</tr>
<tr>
<td>Bustpoint Height</td>
<td>0.356</td>
<td>214.60 *</td>
<td>0.032</td>
<td>0.77</td>
<td>0.304</td>
<td>9.61 *</td>
</tr>
<tr>
<td>Waist Height</td>
<td>0.133</td>
<td>60.11</td>
<td>0.016</td>
<td>0.41</td>
<td>0.271</td>
<td>7.72</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>0.293</td>
<td>161.58 *</td>
<td>0.090</td>
<td>2.72 *</td>
<td>0.224</td>
<td>8.34 *</td>
</tr>
<tr>
<td>Sleeve Inseam</td>
<td>0.244</td>
<td>125.59 *</td>
<td>0.040</td>
<td>2.09 *</td>
<td>0.078</td>
<td>5.68</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>0.374</td>
<td>232.39 *</td>
<td>0.059</td>
<td>2.74 *</td>
<td>0.116</td>
<td>7.81</td>
</tr>
<tr>
<td>Stature</td>
<td>0.413</td>
<td>272.60 *</td>
<td>0.077</td>
<td>1.63</td>
<td>0.397</td>
<td>10.90 *</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>0.323</td>
<td>185.78 *</td>
<td>0.013</td>
<td>0.58</td>
<td>0.202</td>
<td>10.49 *</td>
</tr>
<tr>
<td>Knee Height, Sitting</td>
<td>0.396</td>
<td>254.17 *</td>
<td>0.046</td>
<td>2.48 *</td>
<td>0.154</td>
<td>10.80 *</td>
</tr>
<tr>
<td>Biceps Circ., Flexed</td>
<td>0.785</td>
<td>1409.78 *</td>
<td>0.232</td>
<td>22.05 *</td>
<td>0.132</td>
<td>14.88 *</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>0.708</td>
<td>937.74 *</td>
<td>0.565</td>
<td>15.68 *</td>
<td>0.468</td>
<td>15.79 *</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>0.694</td>
<td>876.23 *</td>
<td>0.365</td>
<td>24.22 *</td>
<td>0.108</td>
<td>7.40 *</td>
</tr>
<tr>
<td>Intercyce Front</td>
<td>0.607</td>
<td>597.87 *</td>
<td>0.180</td>
<td>16.53 *</td>
<td>0.027</td>
<td>4.04</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>0.762</td>
<td>1239.75 *</td>
<td>0.784</td>
<td>30.39 *</td>
<td>0.245</td>
<td>8.91</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>0.396</td>
<td>254.26 *</td>
<td>0.027</td>
<td>3.31 *</td>
<td>0.101</td>
<td>14.01 *</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>0.337</td>
<td>197.57 *</td>
<td>0.023</td>
<td>1.11</td>
<td>0.100</td>
<td>7.25</td>
</tr>
<tr>
<td>Back Arc, Waist</td>
<td>0.667</td>
<td>774.18 *</td>
<td>0.286</td>
<td>15.73 *</td>
<td>0.223</td>
<td>13.95 *</td>
</tr>
</tbody>
</table>

* p < 0.05

D: did not enter model due to insufficient tolerance
Table 13. Regression Coefficient of Sex-Hip Circumference as a Percent of the Regression Coefficient of Hip Circumference

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>HIP CIRCUMFERENCE</th>
<th>SEX-HIP CIRCUMFERENCE</th>
<th>SEX-HIP CIRCUMFERENCE AS A PERC. OF HIP CIRCUMFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coeff.  T-Ratio</td>
<td>Coeff.  T-Ratio</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>2.144  41.77 *</td>
<td>-0.112  -13.62 *</td>
<td>-5.20</td>
</tr>
<tr>
<td>Axilla Height</td>
<td>0.420  10.88 *</td>
<td>-0.079  -12.65 *</td>
<td>-18.73</td>
</tr>
<tr>
<td>Bustpoint Height</td>
<td>0.381  9.61 *</td>
<td>-0.090  -14.15 *</td>
<td>-23.50</td>
</tr>
<tr>
<td>Waist Height</td>
<td>0.289  7.72 *</td>
<td>-0.023  -3.84 *</td>
<td>-7.94</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>0.263  8.34 *</td>
<td>-0.046  -9.22 *</td>
<td>-17.64</td>
</tr>
<tr>
<td>Sleeve Inseam</td>
<td>0.103  5.68 *</td>
<td>-0.029  -9.98 *</td>
<td>-28.02</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>0.157  7.61 *</td>
<td>-0.045  -13.80 *</td>
<td>-28.91</td>
</tr>
<tr>
<td>Stature</td>
<td>0.489  10.90 *</td>
<td>-0.106  -14.85 *</td>
<td>-21.74</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>0.240  10.49 *</td>
<td>-0.044  -12.07 *</td>
<td>-18.36</td>
</tr>
<tr>
<td>Knee Height, Sitting</td>
<td>0.186  10.60 *</td>
<td>-0.036  -12.97 *</td>
<td>-19.52</td>
</tr>
<tr>
<td>Biceps Circ., Flexed</td>
<td>0.148  14.89 *</td>
<td>-0.019  -11.90 *</td>
<td>-12.76</td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>0.507  15.79 *</td>
<td>-0.035  -6.81 *</td>
<td>-6.88</td>
</tr>
<tr>
<td>Back Arc, Bust</td>
<td>0.106  7.40 *</td>
<td>0.003   1.51</td>
<td>3.26</td>
</tr>
<tr>
<td>Interscyte Front</td>
<td>0.042  4.04 *</td>
<td>-0.016  -9.62 *</td>
<td>-37.99</td>
</tr>
<tr>
<td>Bust Circumference</td>
<td>0.218  8.91 *</td>
<td>0.033   8.59 *</td>
<td>15.39</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>0.109  14.01 *</td>
<td>-0.007  -5.54 *</td>
<td>-6.31</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>0.143  7.25 *</td>
<td>-0.045  -14.34 *</td>
<td>-31.56</td>
</tr>
<tr>
<td>Back Arc, Waist</td>
<td>0.240  13.95 *</td>
<td>-0.015  -5.37 *</td>
<td>-6.15</td>
</tr>
</tbody>
</table>

* p < 0.05
Tables 11 and 13 are included in the analysis to better understand the extent of disproportionality across gender groups. In these tables, the estimated coefficients of the cross-product interactions are compared to the estimated coefficients of the measurement that is used in conjunction with sex to produce the cross-product variable. The comparisons of these coefficients illustrate the nature of the disproportionality between the two genders.

Table 9 contains the regression results in which stature and weight were used as independent variables. All models are significant, with 14 of the 18 models having coefficients of determination \((R^2)\) in excess of 0.700. Neither stature nor the interaction of sex and weight attained sufficient tolerance levels to enter the models. However, the sex-stature interaction term was found to be significant for all 18 models. Weight was found to be significant for all variable models except axilla and buttock heights and sleeve outseam. Sex was not significant for bust, sitting and knee heights as well as sleeve inseam and bust circumference.

In terms of the direction of associations as measured by the significant regression coefficients, weight was found to be negatively correlated with the height and length measures with the exception of sitting and knee heights, and waist back length. However, all circumference and arc variables are positively associated with the independent variable weight.

With regard to the dichotomous variable sex (where males are coded zero and females are coded one), there are significant positive associations between this measure and axilla, waist and buttock heights and hip and ankle circumferences. On the other hand, negative association exists between sex and shoulder, bicep and waist circumferences, sleeve outseam, back/bust, back/waist and interscye arcs and waist back length. The significant aspect of these signs in terms of anthropometric proportionality and the sex variable is that there appears to be a lack of consistency across types of measures. For example, sex is associated both positively and negatively with height and length measures as well as with circumferences and arcs.

The final variable in Table 9 to be discussed is the cross-product interaction between sex and stature. As noted earlier, this variable was significant for all models. In addition, the pattern of the signs of the coefficients illustrates the manner in which the lack of cross-gender proportionality affects male and female anthropometry. For example, males appear larger throughout the torso than females, once stature is controlled. Thus, a flight suit or
coverall garment that is designed using a unisex model where stature and weight are the driving variables for estimating other important body dimensions is likely to fit too loosely on women and too tight on men.

Tables 10 and 12 contain the results of the regression analyses with stature and shoulder circumference and shoulder and hip circumferences as the independent variables, respectively. Of interest in both tables is the fact the sex never enters the models due to a lack of sufficient tolerance. Thus, in these two analyses gender differences have been accounted for by the independent variables and/or the cross-product interaction terms.

Stature, shoulder circumference, and sex-shoulder circumference interaction are the only terms to enter the estimated regression equations for the model using stature and shoulder circumference as the independent variables (Table 11). While all equations are significant, not all variables contribute significantly. Stature, shoulder circumference and sex-shoulder circumference interaction are significant for 14, 16 and 15 equations respectively. Stature is positively associated with all significant variables except biceps circumference, while shoulder circumference is positively associated with all variables other than axilla, bust and waist heights and sleeve inseam. The direction of association between the interaction term and the dependent variables is somewhat more complicated. Those estimated interaction coefficients that have negative signs include both height and length measures as well as circumference and arc dimensions. Specifically, bust height, sleeve outseam, biceps circumference, interscye front and waist back length all exhibit a negative sign.

Table 11 contains information as to the extent of gender differences in the relational calculus between shoulder circumference and the dependent variables. The far right column of the table depicts the coefficients for the cross-product as a percent of the coefficients for the variable shoulder circumference. In seven of the 18 models (axilla, waist, buttock, and sitting heights; sleeve outseam; waist back length; and hip circumference), the structural relationships between shoulder circumference and the independent variables for total sample and females differ by more than 10%. Furthermore, five of the seven differences are 40% or more. In one model, buttock height, the difference is more than 700%. However, in this particular model the coefficient between shoulder circumference and the dependent variable is statistically insignificant.
The signs associated with each of the coefficients for the cross-product interactions is also noteworthy. Once shoulder circumference and stature are controlled, women appear to have significantly greater weight; axilla, waist, and buttock heights; hip, bust, and ankle circumferences; as well as waist and bust back arcs. However, they have smaller bust heights, sleeve outseams, flexed biceps circumferences, interscyce front, and waist back lengths.

Table 12 contains the regression analyses where shoulder and hip circumferences are used as the dependent variables. In these models the dichotomous gender variable and the cross-product interaction between sex and shoulder circumference fail to meet minimum tolerance levels and are excluded.

In Table 12 all 18 models are significant. However, only four of the models have coefficients of determination of 0.700 or greater. The estimated coefficients for hip circumference are significant for all 18 models, while the coefficients for shoulder circumference are significant for only 12. The coefficients for the hip circumference-sex interaction are significant for 17 models.

The consistency of the signs of the estimated regression coefficients is notable. In all models both shoulder and hip circumferences are positively related to the dependent measure, while the signs of the coefficients for the sex-hip circumference interaction are all negative with the exception of bust circumference.

Table 13 contains information illustrating the manner in which the structural coefficients between hip circumference and the independent variables vary across genders. There are 13 models where the estimated coefficients for the sex-hip circumference interaction are 10% or more of the corresponding coefficient for hip circumference. In 12 of the 13 models, the female coefficients are less than those for the total sample. Only in the model where bust circumference is the dependent variable is the estimated coefficient for women greater than that for the total sample, once shoulder circumference is controlled.

Thus far, the results from the regression analyses indicate that stature and weight are the best predictor variables of the anthropometric measures used in the analyses. This is evident by the greater proportion of models with coefficients of determination which exceed 0.700. However, the analyses also demonstrate a considerable lack of proportionality between stature
and the dependent variables. In fact, stature fails to enter the models and only impacts the cross-product interaction with sex.

The models which use stature and shoulder circumference as predictor variables are slightly less adequate in their ability to account for variation in the dependent variables than those estimated using weight and stature. For example, while 14 of the weight and stature models had R² values of 0.700 or greater, only 10 of the 18 coefficients of determination associated with the shoulder circumference and stature models attained this magnitude. In this latter set of models shoulder circumference produces the lack of proportionality. The most interesting lack of proportionality occurs with regard to the prediction of height measures. In general, the analysis indicates that a unisex model using shoulder circumference and stature as predictor variables is likely to underestimate axilla, waist, and buttock heights for females, yet overestimate bustpoint height.

The final set of prediction models observed included hip and shoulder circumferences as the predictor variables. This set was characterized by having the lowest R² values with only four models achieving coefficients of determination of 0.700 or greater. Furthermore, hip circumference was the measure that interacted with sex. Yet, the pattern of interaction was considerably more consistent than that observed in the previous two sets of models. That is, the statistically significant estimated coefficients for the cross-product interaction of sex and hip circumference were all signed negative, with the exception of bust circumference.

Table 14 contains a summary of the differences in the output of the male and female specific regression models. A more detailed listing of the differences is provided in Tables 18 through 20, Appendix C. Three sets of sex specific prediction equations were used. The first set used stature and weight as predictor variables, the second used stature and shoulder circumference, while the third used hip and shoulder circumferences. Input data for these variables were obtained by selecting values common to both the male and female sub-samples. After estimating values for the dependent variables, corresponding female values were subtracted from the male estimates. Table 14 contains the extreme values obtained for each dependent variable.

When stature and weight were used as predictor variables, the greatest differences occurred for hip and shoulder circumferences and waist height. Other variables with differences in excess of 30mm include axilla and buttock heights, waist back length, and waist and flexed
### Table 14. Maximum and Minimum Differences Between Male and Female Estimated Values From Separate Regression Models

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>Stature &amp; Weight</th>
<th>Stature &amp; Shoulder Circumference</th>
<th>Hip &amp; Shoulder Circumference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
<td>Minimum</td>
<td>Maximum</td>
</tr>
<tr>
<td>Stature</td>
<td>142.94</td>
<td>75.38</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>262.55</td>
<td>16.94</td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>-83.80</td>
<td>-191.29</td>
<td></td>
</tr>
<tr>
<td>Hip Circumference</td>
<td>67.08</td>
<td>50.11</td>
<td>-102.43</td>
</tr>
<tr>
<td>Axilla Height</td>
<td>-17.87</td>
<td>-17.87</td>
<td>120.18</td>
</tr>
<tr>
<td>Waist Height</td>
<td>-41.81</td>
<td></td>
<td>-12.68</td>
</tr>
<tr>
<td>Bustpoint/Chest Height</td>
<td>7.37</td>
<td>1.61</td>
<td>116.44</td>
</tr>
<tr>
<td>Buttock Height</td>
<td>-2.57</td>
<td>-33.94</td>
<td>76.74</td>
</tr>
<tr>
<td>Sitting Height</td>
<td>-7.05</td>
<td></td>
<td>41.01</td>
</tr>
<tr>
<td>Knee Height, Sitting</td>
<td>0.04</td>
<td>-5.98</td>
<td>64.08</td>
</tr>
<tr>
<td>Sleeve Inseam</td>
<td>0.38</td>
<td>0.02</td>
<td>41.01</td>
</tr>
<tr>
<td>Sleeve Outseam</td>
<td>69.50</td>
<td>26.70</td>
<td></td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>70.68</td>
<td>26.98</td>
<td></td>
</tr>
<tr>
<td>Waist Circumference</td>
<td>166.03</td>
<td>55.13</td>
<td></td>
</tr>
<tr>
<td>Bust/Chest Circumference</td>
<td>32.47</td>
<td>-13.86</td>
<td></td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>13.13</td>
<td>2.86</td>
<td></td>
</tr>
<tr>
<td>Bicep Circumference, Flexed</td>
<td>23.15</td>
<td>11.97</td>
<td></td>
</tr>
<tr>
<td>Interscy Front</td>
<td>19.11</td>
<td>12.85</td>
<td></td>
</tr>
<tr>
<td>Back Arc, Bust/Chest</td>
<td>12.54</td>
<td>-14.13</td>
<td></td>
</tr>
<tr>
<td>Back Arc, Waist</td>
<td>84.18</td>
<td>-32.30</td>
<td></td>
</tr>
</tbody>
</table>
biceps circumferences. Axilla, waist and buttock heights and hip circumference are the only measures where the female model consistently predicts values greater than the male equations.

In the models which used stature and shoulder circumference as the predictor variables, five variables exhibit differences greater than 30mm. These include hip and bust/chest circumferences, waist and buttock heights, and waist back length, with hip circumference, waist height and bust/chest circumference having the greatest differences. The predicted values for females were consistently greater than those for males in 10 of the 18 models.

The final set of models employed hip and shoulder circumferences to predict the independent variables. In these models the greatest differences occurred in stature, axilla height, bustpoint/chest height, and waist circumference. All but four measures (ankle and flexed biceps circumferences, interscye front, and back arc, bust) exhibited differences greater than 30mm. In addition, waist height was the only variable for which the female estimated values always exceed the male values.

In summary, none of the three sets of models appear to 1) do an adequate job of estimating the values of the independent variables and 2) effectively compensate for the absence of cross-gender anthropometric proportionality. In the two sets of models where stature and weight and stature and shoulder circumference were used as predictor variables, the presence of disproportionality is evident by the relatively large number of measures in which the estimated female values exceed the corresponding male values. This presence implies that "down-sizing" of coverall type equipment designed and sized for men is inappropriate for female personnel. However, even though the set of models which rely on hip and shoulder circumferences as predictor variables partially alleviates this problem of disproportionality, the results indicate a general lack of "goodness of fit" of the estimated regression equations to the actual data as evidenced by the relatively low values of $R^2$ for the models.
REFERENCES


The variable descriptions included in this Appendix are modified from figures shown in Tebbetts, Churchill & McConville (1980).
Figure 7. Variable Descriptions used for Coverall/Flightsuit Analysis
Figure 7 (Continued). Variable Descriptions used for Coverall/Flightsuit Analysis
1. WEIGHT: weight of subject wearing panties and bra (not pictured).
2. STATURE: vertical distance from floor to top of the head.
3. AXILLA HEIGHT: vertical distance from floor to armpit.
4. BUSTPOINT HEIGHT: vertical distance from floor to tip of the bra.
5. WAIST HEIGHT: vertical distance from floor to natural waist level.
6. BUTTOCK HEIGHT: vertical distance from floor to the point of maximum protrusion of the buttock.
7. SLEEVE INSEAM: distance from the anterior edge of the armpit to the little finger side of the wrist measured with the arm slightly abducted, the palm held forward, and the tape tense.
8. SLEEVE OUTSEAM: distance from acromial to the thumb side of the wrist; arm is slightly abducted, the palm held forward, and tape tense.
9. SHOULDER CIRCUMFERENCE: horizontal circumference of the shoulders at the level of the greatest lateral protrusion of the deltoid muscles.
10. SITTING HEIGHT: vertical distance from sitting surface top of the head.
11. KNEE HEIGHT, SITTING: vertical distance from the footrest surface to a point on the thigh 5 cm proximal to the anterior surface of the patella.
12. HIP CIRCUMFERENCE: maximum circumference of the hips at the level of the maximum posterior protrusion of the buttocks.
13. BICEPS CIRCUMFERENCE, FLEXED: circumference of the arm at the level of the maximal protrusion of the biceps, measured with the elbow flexed 90 degrees, the upper arm horizontal and the fist tightly clenched.
14. WAIST CIRCUMFERENCE: horizontal circumference of the waist at 'natural' waist level.
15. BACK ARC, BUST: surface distance across the back between midaxillary lines at the level of the bra points.
16. INTERCYE FRONT: surface distance across the back between points midway between the posterior edges of armpits and acromial points.
17. BUST CIRCUMFERENCE: horizontal circumference if the trunk measured with the tape passing over the bra points.
18. ANKLE CIRCUMFERENCE: minimum circumference of the ankle.
19. WAIST BACK LENGTH: surface distance from the waist to cervical.
20. **BACK ARC, WAIST:** surface distance across the back between midaxillary lines at waist level.
APPENDIX B

MALE AND FEMALE REGRESSION EQUATIONS FOR ALL MODELS
Table 15. Regression Analysis of Coverall/Flightsuit Measures Using Stature and Weight as Independent Variables

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>STATURE</th>
<th>WEIGHT</th>
<th>CONSTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>AXILLA HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.946</td>
<td>1640.71</td>
<td>0.854</td>
<td>49.16</td>
</tr>
<tr>
<td>female</td>
<td>0.941</td>
<td>7771.91</td>
<td>0.832</td>
<td>104.28</td>
</tr>
<tr>
<td>BUSTPOINT HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.939</td>
<td>1441.95</td>
<td>0.830</td>
<td>47.05</td>
</tr>
<tr>
<td>female</td>
<td>0.887</td>
<td>3787.87</td>
<td>0.839</td>
<td>75.22</td>
</tr>
<tr>
<td>WAIST HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.772</td>
<td>318.48</td>
<td>0.817</td>
<td>23.49</td>
</tr>
<tr>
<td>female</td>
<td>0.821</td>
<td>2215.94</td>
<td>0.741</td>
<td>57.72</td>
</tr>
<tr>
<td>BUTTOCK HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.818</td>
<td>421.26</td>
<td>0.666</td>
<td>25.44</td>
</tr>
<tr>
<td>female</td>
<td>0.768</td>
<td>1599.42</td>
<td>0.577</td>
<td>45.53</td>
</tr>
<tr>
<td>SLEEVE INSEAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.654</td>
<td>177.99</td>
<td>0.331</td>
<td>17.12</td>
</tr>
<tr>
<td>female</td>
<td>0.634</td>
<td>837.12</td>
<td>0.323</td>
<td>36.59</td>
</tr>
<tr>
<td>SLEEVE OUTSEAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.669</td>
<td>190.17</td>
<td>0.364</td>
<td>15.95</td>
</tr>
<tr>
<td>female</td>
<td>0.667</td>
<td>968.34</td>
<td>0.364</td>
<td>37.52</td>
</tr>
<tr>
<td>SHOULDER CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.764</td>
<td>304.41</td>
<td>-0.158</td>
<td>-4.15</td>
</tr>
<tr>
<td>female</td>
<td>0.695</td>
<td>1102.10</td>
<td>-0.122</td>
<td>-7.12</td>
</tr>
</tbody>
</table>
Table 15. Continued page 2 of 3

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>STATURE</th>
<th>WEIGHT</th>
<th>CONSTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITTING HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.601</td>
<td>141.36 *</td>
<td>0.344</td>
<td>13.09 *</td>
</tr>
<tr>
<td>female</td>
<td>0.666</td>
<td>965.84 *</td>
<td>0.405</td>
<td>36.06 *</td>
</tr>
<tr>
<td>KNEE HEIGHT, SITTING</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.803</td>
<td>382.39 *</td>
<td>0.349</td>
<td>21.27 *</td>
</tr>
<tr>
<td>female</td>
<td>0.788</td>
<td>1802.16 *</td>
<td>0.322</td>
<td>46.77 *</td>
</tr>
<tr>
<td>HIP CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.904</td>
<td>881.87 *</td>
<td>-0.089</td>
<td>-3.65 *</td>
</tr>
<tr>
<td>female</td>
<td>0.816</td>
<td>2148.93 *</td>
<td>-0.094</td>
<td>-6.02 *</td>
</tr>
<tr>
<td>BICEPS CIRC, FLEXED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.758</td>
<td>294.78 *</td>
<td>-0.131</td>
<td>-7.83 *</td>
</tr>
<tr>
<td>female</td>
<td>0.756</td>
<td>1496.59 *</td>
<td>-0.116</td>
<td>-17.47 *</td>
</tr>
<tr>
<td>WAIST CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.876</td>
<td>662.46 *</td>
<td>-0.304</td>
<td>-8.27 *</td>
</tr>
<tr>
<td>female</td>
<td>0.678</td>
<td>1017.76 *</td>
<td>-0.297</td>
<td>-13.07 *</td>
</tr>
<tr>
<td>BACK CURVATURE, BUST</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.736</td>
<td>262.50 *</td>
<td>-0.115</td>
<td>-5.24 *</td>
</tr>
<tr>
<td>female</td>
<td>0.607</td>
<td>746.04 *</td>
<td>-0.122</td>
<td>-10.67 *</td>
</tr>
<tr>
<td>INTERSCYE FRONT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.460</td>
<td>80.05 *</td>
<td>0.027</td>
<td>1.53</td>
</tr>
<tr>
<td>female</td>
<td>0.322</td>
<td>229.49 *</td>
<td>0.039</td>
<td>4.63 *</td>
</tr>
</tbody>
</table>
Table 15. Continued page 3 of 3

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>STATURE</th>
<th>WEIGHT</th>
<th>CONSTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUST CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.854</td>
<td>548.16 *</td>
<td>-0.263</td>
<td>-8.19 *</td>
</tr>
<tr>
<td>female</td>
<td>0.709</td>
<td>1178.45 *</td>
<td>-0.256</td>
<td>-12.74 *</td>
</tr>
<tr>
<td>ANKLE CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.683</td>
<td>202.67 *</td>
<td>0.016</td>
<td>1.63</td>
</tr>
<tr>
<td>female</td>
<td>0.397</td>
<td>317.87 *</td>
<td>0.010</td>
<td>1.67</td>
</tr>
<tr>
<td>WAIST BACK LENGTH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.347</td>
<td>49.86 *</td>
<td>0.143</td>
<td>4.53 *</td>
</tr>
<tr>
<td>female</td>
<td>0.275</td>
<td>183.16 *</td>
<td>0.206</td>
<td>15.53 *</td>
</tr>
<tr>
<td>BACK CURVATURE, WAIST</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.811</td>
<td>404.65 *</td>
<td>-0.159</td>
<td>-6.68 *</td>
</tr>
<tr>
<td>female</td>
<td>0.640</td>
<td>858.29 *</td>
<td>-0.153</td>
<td>-12.67 *</td>
</tr>
</tbody>
</table>

* p < 0.05
N (males) = 191
N (females) = 970
<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>STATURE</th>
<th>SHOULDER CIRCUMFERENCE</th>
<th>CONSTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>AXILLA HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.947</td>
<td>1693.60 *</td>
<td>0.850</td>
<td>55.60 *</td>
</tr>
<tr>
<td>female</td>
<td>0.941</td>
<td>7777.60 *</td>
<td>0.840</td>
<td>117.50 *</td>
</tr>
<tr>
<td>BUSTPOINT HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.937</td>
<td>1416.10 *</td>
<td>0.810</td>
<td>51.00 *</td>
</tr>
<tr>
<td>female</td>
<td>0.866</td>
<td>3773.10 *</td>
<td>0.830</td>
<td>82.80 *</td>
</tr>
<tr>
<td>WAIST HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.755</td>
<td>294.20 *</td>
<td>0.760</td>
<td>23.80 *</td>
</tr>
<tr>
<td>female</td>
<td>0.820</td>
<td>2205.50 *</td>
<td>0.730</td>
<td>63.40 *</td>
</tr>
<tr>
<td>BUTTOCK HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.816</td>
<td>421.50 *</td>
<td>0.650</td>
<td>27.90 *</td>
</tr>
<tr>
<td>female</td>
<td>0.768</td>
<td>1608.60 *</td>
<td>0.580</td>
<td>51.80 *</td>
</tr>
<tr>
<td>SLEEVE INSEAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.639</td>
<td>169.10 *</td>
<td>0.310</td>
<td>17.60 *</td>
</tr>
<tr>
<td>female</td>
<td>0.627</td>
<td>814.80 *</td>
<td>0.310</td>
<td>38.60 *</td>
</tr>
<tr>
<td>SLEEVE OUTSEAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.668</td>
<td>192.50 *</td>
<td>0.360</td>
<td>17.90 *</td>
</tr>
<tr>
<td>female</td>
<td>0.666</td>
<td>967.10 *</td>
<td>0.360</td>
<td>41.10 *</td>
</tr>
<tr>
<td>WEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.810</td>
<td>405.80 *</td>
<td>1.000</td>
<td>8.30 *</td>
</tr>
<tr>
<td>female</td>
<td>0.757</td>
<td>1506.30 *</td>
<td>0.850</td>
<td>17.60 *</td>
</tr>
</tbody>
</table>
Table 16. Continued page 2 of 3

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>STATURE</th>
<th>SHOULDER CIRCUMFERENCE</th>
<th>CONSTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>SITTING HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.595</td>
<td>140.40 *</td>
<td>0.360</td>
<td>15.10 *</td>
</tr>
<tr>
<td>female</td>
<td>0.685</td>
<td>964.40 *</td>
<td>0.410</td>
<td>40.10 *</td>
</tr>
<tr>
<td>KNEE HEIGHT, SITTING</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.795</td>
<td>369.70 *</td>
<td>0.370</td>
<td>24.70 *</td>
</tr>
<tr>
<td>female</td>
<td>0.785</td>
<td>1770.50 *</td>
<td>0.330</td>
<td>54.10 *</td>
</tr>
<tr>
<td>HIP CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.712</td>
<td>236.40 *</td>
<td>0.160</td>
<td>4.40 *</td>
</tr>
<tr>
<td>female</td>
<td>0.538</td>
<td>564.40 *</td>
<td>0.190</td>
<td>8.60 *</td>
</tr>
<tr>
<td>BICEPS CIRC, FLEXED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.704</td>
<td>227.40 *</td>
<td>-0.030</td>
<td>-2.00 *</td>
</tr>
<tr>
<td>female</td>
<td>0.612</td>
<td>766.00 *</td>
<td>-0.020</td>
<td>-2.80 *</td>
</tr>
<tr>
<td>WAIST CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.592</td>
<td>139.10 *</td>
<td>0.070</td>
<td>1.20</td>
</tr>
<tr>
<td>female</td>
<td>0.548</td>
<td>588.60 *</td>
<td>-0.030</td>
<td>-1.20</td>
</tr>
<tr>
<td>BACK CURVATURE, BUST</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.694</td>
<td>216.50 *</td>
<td>0.000</td>
<td>0.06</td>
</tr>
<tr>
<td>female</td>
<td>0.602</td>
<td>732.70 *</td>
<td>-0.020</td>
<td>-2.00 *</td>
</tr>
<tr>
<td>INTERSCYE FRONT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.535</td>
<td>110.20 *</td>
<td>0.060</td>
<td>4.10 *</td>
</tr>
<tr>
<td>female</td>
<td>0.415</td>
<td>344.40 *</td>
<td>0.060</td>
<td>8.50 *</td>
</tr>
</tbody>
</table>
Table 18. Continued page 3 of 3

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>STATURE</th>
<th>SHOULDER CIRCUMFERENCE</th>
<th>CONSTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUST CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.821</td>
<td>437.20 *</td>
<td>-0.020</td>
<td>-0.60</td>
</tr>
<tr>
<td>female</td>
<td>0.691</td>
<td>1082.10 *</td>
<td>-0.030</td>
<td>-1.60</td>
</tr>
<tr>
<td>ANKLE CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.530</td>
<td>108.00 *</td>
<td>-0.060</td>
<td>5.90 *</td>
</tr>
<tr>
<td>female</td>
<td>0.248</td>
<td>160.40 *</td>
<td>0.050</td>
<td>8.70 *</td>
</tr>
<tr>
<td>WAIST BACK LENGTH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.299</td>
<td>41.50 *</td>
<td>0.190</td>
<td>6.70 *</td>
</tr>
<tr>
<td>female</td>
<td>0.273</td>
<td>182.60 *</td>
<td>0.210</td>
<td>17.90 *</td>
</tr>
<tr>
<td>BACK CURVATURE, WAIST</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.542</td>
<td>113.60 *</td>
<td>0.030</td>
<td>0.98</td>
</tr>
<tr>
<td>female</td>
<td>0.524</td>
<td>534.30 *</td>
<td>-0.020</td>
<td>-1.80</td>
</tr>
</tbody>
</table>

* p < 0.05
N (males) = 191
N (females) = 970
Table 17. Regression Analysis of Coverall/Flightsuit Measures using Hip and Shoulder Circumference as Independent Variables

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>HIP CIRCUMFERENCE</th>
<th>SHOULDER CIRCUMFERENCE</th>
<th>CONSTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>AXILLA HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.171</td>
<td>20.54 *</td>
<td>0.531</td>
<td>4.73 *</td>
</tr>
<tr>
<td>female</td>
<td>0.171</td>
<td>100.65 *</td>
<td>0.328</td>
<td>8.79 *</td>
</tr>
<tr>
<td>BUSTPOINT HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.136</td>
<td>15.95 *</td>
<td>0.429</td>
<td>3.92 *</td>
</tr>
<tr>
<td>female</td>
<td>0.129</td>
<td>72.46 *</td>
<td>0.287</td>
<td>7.46 *</td>
</tr>
<tr>
<td>WAIST HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.071</td>
<td>8.25 *</td>
<td>0.371</td>
<td>3.20 *</td>
</tr>
<tr>
<td>female</td>
<td>0.119</td>
<td>66.68 *</td>
<td>0.257</td>
<td>7.26 *</td>
</tr>
<tr>
<td>BUTTOCK HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.111</td>
<td>12.84 *</td>
<td>0.338</td>
<td>3.53 *</td>
</tr>
<tr>
<td>female</td>
<td>0.168</td>
<td>98.61 *</td>
<td>0.209</td>
<td>6.99 *</td>
</tr>
<tr>
<td>SLEEVE INSEAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.080</td>
<td>9.22 *</td>
<td>0.137</td>
<td>2.62 *</td>
</tr>
<tr>
<td>female</td>
<td>0.068</td>
<td>36.37 *</td>
<td>0.070</td>
<td>4.01 *</td>
</tr>
<tr>
<td>SLEEVE OUTSEAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.179</td>
<td>21.64 *</td>
<td>0.242</td>
<td>4.06 *</td>
</tr>
<tr>
<td>female</td>
<td>0.106</td>
<td>58.68 *</td>
<td>0.099</td>
<td>5.02 *</td>
</tr>
<tr>
<td>WEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.915</td>
<td>1022.37 *</td>
<td>2.948</td>
<td>19.68 *</td>
</tr>
<tr>
<td>female</td>
<td>0.879</td>
<td>3515.04 *</td>
<td>1.905</td>
<td>39.99 *</td>
</tr>
</tbody>
</table>
Table 17. Continued page 2 of 3

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>HIP CIRCUMFERENCE</th>
<th>SHOULDER CIRCUMFERENCE</th>
<th>CONSTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R-SQ</td>
<td>F-Ratio</td>
<td>Coeff. T-Ratio</td>
<td>Coeff. T-Ratio</td>
</tr>
<tr>
<td>SITTING HEIGHT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.157</td>
<td>18.64 *</td>
<td>0.225 3.58 *</td>
<td>-0.012 -0.19</td>
</tr>
<tr>
<td>female</td>
<td>0.157</td>
<td>91.08 *</td>
<td>0.199 8.94 *</td>
<td>0.021 0.78</td>
</tr>
<tr>
<td>KNEE HEIGHT, SITTING</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.253</td>
<td>33.22 *</td>
<td>0.290 5.51 *</td>
<td>-0.063 -1.20</td>
</tr>
<tr>
<td>female</td>
<td>0.190</td>
<td>114.71 *</td>
<td>0.135 8.09 *</td>
<td>0.065 3.29 *</td>
</tr>
<tr>
<td>STATURE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.195</td>
<td>24.04 *</td>
<td>0.569 4.40 *</td>
<td>-0.084 -0.65</td>
</tr>
<tr>
<td>female</td>
<td>0.179</td>
<td>106.84 *</td>
<td>0.374 8.65 *</td>
<td>0.111 2.18 *</td>
</tr>
<tr>
<td>BICEPS CIRC, FLEXED</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.719</td>
<td>244.62 *</td>
<td>0.113 3.80 *</td>
<td>0.269 9.06 *</td>
</tr>
<tr>
<td>female</td>
<td>0.676</td>
<td>1011.50 *</td>
<td>0.134 14.11 *</td>
<td>0.225 20.11 *</td>
</tr>
<tr>
<td>WAIST CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.812</td>
<td>410.92 *</td>
<td>1.116 14.91 *</td>
<td>0.102 1.36</td>
</tr>
<tr>
<td>female</td>
<td>0.608</td>
<td>752.44 *</td>
<td>0.382 12.22 *</td>
<td>0.636 17.29 *</td>
</tr>
<tr>
<td>BACK CURVATURE, BUST</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.729</td>
<td>256.87 *</td>
<td>0.182 4.95 *</td>
<td>0.305 8.29 *</td>
</tr>
<tr>
<td>female</td>
<td>0.619</td>
<td>788.45 *</td>
<td>0.098 6.97 *</td>
<td>0.374 22.63 *</td>
</tr>
<tr>
<td>INTERSCYCE FRONT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.502</td>
<td>96.69 *</td>
<td>0.053 1.87</td>
<td>0.174 6.17 *</td>
</tr>
<tr>
<td>female</td>
<td>0.375</td>
<td>13.51 *</td>
<td>0.024 2.40 *</td>
<td>0.180 15.25 *</td>
</tr>
</tbody>
</table>
Table 17. Continued page 3 of 3

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>ADJ. R-SQUARED</th>
<th>HIP CIRCUMFERENCE</th>
<th>SHOULDER CIRCUMFERENCE</th>
<th>CONSTANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUST CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.880</td>
<td>585.71</td>
<td>0.378</td>
<td>7.28</td>
</tr>
<tr>
<td>female</td>
<td>0.715</td>
<td>1214.56</td>
<td>0.228</td>
<td>9.21</td>
</tr>
<tr>
<td>ANKLE CIRCUMFERENCE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.574</td>
<td>129.13</td>
<td>0.145</td>
<td>7.59</td>
</tr>
<tr>
<td>female</td>
<td>0.301</td>
<td>209.64</td>
<td>0.095</td>
<td>12.47</td>
</tr>
<tr>
<td>WAIST BACK LENGTH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.224</td>
<td>28.47</td>
<td>0.265</td>
<td>4.68</td>
</tr>
<tr>
<td>female</td>
<td>0.050</td>
<td>26.27</td>
<td>0.078</td>
<td>4.14</td>
</tr>
<tr>
<td>BACK CURVATURE, WAIST</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>0.749</td>
<td>284.22</td>
<td>0.569</td>
<td>12.50</td>
</tr>
<tr>
<td>female</td>
<td>0.573</td>
<td>652.47</td>
<td>0.177</td>
<td>10.77</td>
</tr>
</tbody>
</table>

* p < 0.05

N (males) = 191
N (females) = 970
APPENDIX C

ESTIMATED DIFFERENCES BETWEEN MALES AND FEMALES
FOR ALL INDEPENDENT VARIABLES, FOR ALL MODELS

NOTE: All Dimensions in millimeters; negative values indicate larger female dimensions.
Table 18. Estimated Male minus Female Computed Values with Stature and Weight as Dependent Variables

<table>
<thead>
<tr>
<th>Stature</th>
<th>Axilla Height</th>
<th>1592</th>
<th>1653</th>
<th>1715</th>
<th>1776</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1256</td>
<td>-12.71</td>
<td>-11.33</td>
<td>-9.96</td>
<td>-8.58</td>
<td></td>
</tr>
<tr>
<td>1718</td>
<td>-18.55</td>
<td>-17.17</td>
<td>-15.80</td>
<td>-14.42</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>-21.47</td>
<td>-20.09</td>
<td>-18.72</td>
<td>-17.34</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stature</th>
<th>Waist Height</th>
<th>1592</th>
<th>1653</th>
<th>1715</th>
<th>1776</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1256</td>
<td>-54.94</td>
<td>-50.27</td>
<td>-45.59</td>
<td>-40.92</td>
<td></td>
</tr>
<tr>
<td>1487</td>
<td>-62.75</td>
<td>-58.08</td>
<td>-53.40</td>
<td>-48.73</td>
<td></td>
</tr>
<tr>
<td>1718</td>
<td>-70.57</td>
<td>-65.89</td>
<td>-61.21</td>
<td>-56.54</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>-78.38</td>
<td>-73.70</td>
<td>-69.03</td>
<td>-64.35</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stature</th>
<th>Bustpoint Height</th>
<th>1592</th>
<th>1653</th>
<th>1715</th>
<th>1776</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1256</td>
<td>3.39</td>
<td>2.85</td>
<td>2.30</td>
<td>1.75</td>
<td></td>
</tr>
<tr>
<td>1487</td>
<td>2.54</td>
<td>1.99</td>
<td>1.45</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>1718</td>
<td>1.69</td>
<td>1.14</td>
<td>0.59</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>0.84</td>
<td>0.29</td>
<td>-0.26</td>
<td>-0.81</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stature</th>
<th>Buttock Height</th>
<th>1592</th>
<th>1653</th>
<th>1715</th>
<th>1776</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1256</td>
<td>-32.80</td>
<td>-27.94</td>
<td>-23.08</td>
<td>-18.21</td>
<td></td>
</tr>
<tr>
<td>1718</td>
<td>-47.18</td>
<td>-42.32</td>
<td>-37.45</td>
<td>-32.59</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>-54.37</td>
<td>-49.50</td>
<td>-44.64</td>
<td>-39.78</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stature</th>
<th>Sleeve Inseam</th>
<th>1592</th>
<th>1653</th>
<th>1715</th>
<th>1776</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1256</td>
<td>-1.21</td>
<td>-0.71</td>
<td>-0.22</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>1487</td>
<td>-1.37</td>
<td>-0.88</td>
<td>-0.39</td>
<td>0.11</td>
<td></td>
</tr>
<tr>
<td>1718</td>
<td>-1.54</td>
<td>-1.05</td>
<td>-0.55</td>
<td>-0.06</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>-1.71</td>
<td>-1.21</td>
<td>-0.72</td>
<td>-0.23</td>
<td></td>
</tr>
</tbody>
</table>
Table 18. Continued page 2 of 4

<table>
<thead>
<tr>
<th></th>
<th>1592</th>
<th>1653</th>
<th>1715</th>
<th>1776</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sleeve Outseam</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1256</td>
<td>7.86</td>
<td>7.86</td>
<td>7.85</td>
</tr>
<tr>
<td></td>
<td>1487</td>
<td>9.75</td>
<td>9.74</td>
<td>9.74</td>
</tr>
<tr>
<td></td>
<td>1718</td>
<td>11.64</td>
<td>11.63</td>
<td>11.63</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>13.52</td>
<td>13.52</td>
<td>13.52</td>
</tr>
<tr>
<td><strong>Stature</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1256</td>
<td>67.08</td>
<td>64.87</td>
<td>62.67</td>
</tr>
<tr>
<td></td>
<td>1487</td>
<td>63.62</td>
<td>61.42</td>
<td>59.22</td>
</tr>
<tr>
<td></td>
<td>1718</td>
<td>60.17</td>
<td>57.97</td>
<td>55.76</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>56.71</td>
<td>54.51</td>
<td>52.31</td>
</tr>
<tr>
<td><strong>Sitting Height</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1256</td>
<td>5.05</td>
<td>1.24</td>
<td>-2.57</td>
</tr>
<tr>
<td></td>
<td>1487</td>
<td>6.57</td>
<td>2.76</td>
<td>-1.05</td>
</tr>
<tr>
<td></td>
<td>1718</td>
<td>8.10</td>
<td>4.29</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>9.62</td>
<td>5.81</td>
<td>2.00</td>
</tr>
<tr>
<td><strong>Knee Height, Sitting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1256</td>
<td>-3.46</td>
<td>-1.79</td>
<td>-0.12</td>
</tr>
<tr>
<td></td>
<td>1487</td>
<td>-3.48</td>
<td>-1.82</td>
<td>-0.15</td>
</tr>
<tr>
<td></td>
<td>1718</td>
<td>-3.51</td>
<td>-1.85</td>
<td>-0.18</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>-3.54</td>
<td>-1.87</td>
<td>-0.21</td>
</tr>
<tr>
<td><strong>Hip Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1256</td>
<td>-52.06</td>
<td>-51.72</td>
<td>-51.38</td>
</tr>
<tr>
<td></td>
<td>1487</td>
<td>-67.10</td>
<td>-66.76</td>
<td>-66.42</td>
</tr>
<tr>
<td></td>
<td>1718</td>
<td>-82.14</td>
<td>-81.80</td>
<td>-81.46</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>-97.18</td>
<td>-96.84</td>
<td>-96.50</td>
</tr>
</tbody>
</table>
Table 18. Continued page 3 of 4

<table>
<thead>
<tr>
<th></th>
<th>1592</th>
<th>1653</th>
<th>1715</th>
<th>1776</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stature</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biceps Circ, Flexed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1256</td>
<td>31.77</td>
<td>30.85</td>
<td>29.93</td>
</tr>
<tr>
<td></td>
<td>1487</td>
<td>28.91</td>
<td>27.99</td>
<td>27.07</td>
</tr>
<tr>
<td></td>
<td>1718</td>
<td>26.05</td>
<td>25.14</td>
<td>24.22</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>23.20</td>
<td>22.28</td>
<td>21.36</td>
</tr>
<tr>
<td><strong>Waist Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1256</td>
<td>40.08</td>
<td>39.66</td>
<td>39.24</td>
</tr>
<tr>
<td></td>
<td>1487</td>
<td>42.11</td>
<td>41.69</td>
<td>41.27</td>
</tr>
<tr>
<td></td>
<td>1718</td>
<td>44.15</td>
<td>43.73</td>
<td>43.31</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>46.18</td>
<td>45.76</td>
<td>45.34</td>
</tr>
<tr>
<td><strong>Back Arc, Bust</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1256</td>
<td>16.45</td>
<td>16.92</td>
<td>17.39</td>
</tr>
<tr>
<td></td>
<td>1487</td>
<td>12.87</td>
<td>13.34</td>
<td>13.81</td>
</tr>
<tr>
<td></td>
<td>1718</td>
<td>9.29</td>
<td>9.76</td>
<td>10.22</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>5.71</td>
<td>6.18</td>
<td>6.64</td>
</tr>
<tr>
<td><strong>Interscye Front</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1256</td>
<td>19.69</td>
<td>18.96</td>
<td>18.23</td>
</tr>
<tr>
<td></td>
<td>1487</td>
<td>20.61</td>
<td>19.89</td>
<td>19.16</td>
</tr>
<tr>
<td></td>
<td>1718</td>
<td>21.54</td>
<td>20.81</td>
<td>20.09</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>22.47</td>
<td>21.74</td>
<td>21.01</td>
</tr>
<tr>
<td><strong>Bust Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>1256</td>
<td>14.23</td>
<td>13.77</td>
<td>13.31</td>
</tr>
<tr>
<td></td>
<td>1487</td>
<td>4.68</td>
<td>4.22</td>
<td>3.76</td>
</tr>
<tr>
<td></td>
<td>1718</td>
<td>-4.88</td>
<td>-5.34</td>
<td>-5.80</td>
</tr>
<tr>
<td></td>
<td>1949</td>
<td>-14.43</td>
<td>-14.89</td>
<td>-15.35</td>
</tr>
<tr>
<td></td>
<td>1592</td>
<td>1653</td>
<td>1715</td>
<td>1776</td>
</tr>
<tr>
<td>---------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td><strong>Stature</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1256</td>
<td>-3.87</td>
<td>-3.45</td>
<td>-3.03</td>
<td>-2.62</td>
</tr>
<tr>
<td>1487</td>
<td>-2.88</td>
<td>-2.46</td>
<td>-2.05</td>
<td>-1.63</td>
</tr>
<tr>
<td>1718</td>
<td>-1.89</td>
<td>-1.47</td>
<td>-1.06</td>
<td>-0.64</td>
</tr>
<tr>
<td>1949</td>
<td>-0.90</td>
<td>-0.48</td>
<td>-0.07</td>
<td>0.35</td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waist Back Length</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1256</td>
<td>18.90</td>
<td>15.00</td>
<td>11.10</td>
<td>7.20</td>
</tr>
<tr>
<td>1718</td>
<td>37.19</td>
<td>33.29</td>
<td>29.39</td>
<td>25.49</td>
</tr>
<tr>
<td>1949</td>
<td>46.33</td>
<td>42.43</td>
<td>38.53</td>
<td>34.63</td>
</tr>
<tr>
<td><strong>Stature</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Back Arc, Waist</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1256</td>
<td>17.58</td>
<td>17.22</td>
<td>16.86</td>
<td>16.50</td>
</tr>
<tr>
<td>1487</td>
<td>19.96</td>
<td>19.60</td>
<td>19.24</td>
<td>18.88</td>
</tr>
<tr>
<td>1718</td>
<td>22.34</td>
<td>21.98</td>
<td>21.62</td>
<td>21.26</td>
</tr>
<tr>
<td>1949</td>
<td>24.71</td>
<td>24.35</td>
<td>23.99</td>
<td>23.63</td>
</tr>
</tbody>
</table>

75
Table 19. Estimated Male minus Female Computed Values with Stature and Shoulder Circumference as Dependent Variables

<table>
<thead>
<tr>
<th></th>
<th>Stature 1591.6</th>
<th>Stature 1653.2</th>
<th>Stature 1714.8</th>
<th>Stature 1776.4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Axilla Height</strong></td>
<td>1591.6</td>
<td>1653.2</td>
<td>1714.8</td>
<td>1776.4</td>
</tr>
<tr>
<td></td>
<td>-9.75</td>
<td>-8.90</td>
<td>-8.05</td>
<td>-7.20</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td>1009</td>
<td>-12.45</td>
<td>-11.61</td>
<td>-10.76</td>
</tr>
<tr>
<td></td>
<td>-15.16</td>
<td>-14.32</td>
<td>-13.47</td>
<td>-12.62</td>
</tr>
<tr>
<td></td>
<td>-17.87</td>
<td>-17.02</td>
<td>-16.18</td>
<td>-15.33</td>
</tr>
<tr>
<td><strong>Waist height</strong></td>
<td>1591.6</td>
<td>1653.2</td>
<td>1714.8</td>
<td>1776.4</td>
</tr>
<tr>
<td></td>
<td>-47.88</td>
<td>-45.85</td>
<td>-43.83</td>
<td>-41.81</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td>1009</td>
<td>-52.81</td>
<td>-50.78</td>
<td>-48.76</td>
</tr>
<tr>
<td></td>
<td>-57.74</td>
<td>-55.72</td>
<td>-53.69</td>
<td>-51.67</td>
</tr>
<tr>
<td></td>
<td>-62.67</td>
<td>-60.65</td>
<td>-58.62</td>
<td>-56.60</td>
</tr>
<tr>
<td><strong>Bustpoint Height</strong></td>
<td>1591.6</td>
<td>1653.2</td>
<td>1714.8</td>
<td>1776.4</td>
</tr>
<tr>
<td></td>
<td>7.37</td>
<td>6.41</td>
<td>5.46</td>
<td>4.50</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td>1009</td>
<td>6.40</td>
<td>5.45</td>
<td>4.49</td>
</tr>
<tr>
<td></td>
<td>5.44</td>
<td>4.48</td>
<td>3.53</td>
<td>2.57</td>
</tr>
<tr>
<td></td>
<td>4.47</td>
<td>3.52</td>
<td>2.56</td>
<td>1.61</td>
</tr>
<tr>
<td><strong>Buttock Height</strong></td>
<td>1591.6</td>
<td>1653.2</td>
<td>1714.8</td>
<td>1776.4</td>
</tr>
<tr>
<td></td>
<td>-15.05</td>
<td>-10.89</td>
<td>-6.73</td>
<td>-2.57</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td>1009</td>
<td>-21.34</td>
<td>-17.19</td>
<td>-13.03</td>
</tr>
<tr>
<td></td>
<td>-27.64</td>
<td>-23.48</td>
<td>-19.32</td>
<td>-15.17</td>
</tr>
<tr>
<td></td>
<td>-33.94</td>
<td>-29.78</td>
<td>-25.62</td>
<td>-21.46</td>
</tr>
<tr>
<td><strong>Sleeve Inseam</strong></td>
<td>1591.6</td>
<td>1653.2</td>
<td>1714.8</td>
<td>1776.4</td>
</tr>
<tr>
<td></td>
<td>0.03</td>
<td>0.15</td>
<td>0.26</td>
<td>0.38</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td>1009</td>
<td>0.03</td>
<td>0.14</td>
<td>0.26</td>
</tr>
<tr>
<td></td>
<td>0.03</td>
<td>0.14</td>
<td>0.26</td>
<td>0.37</td>
</tr>
<tr>
<td></td>
<td>0.02</td>
<td>0.14</td>
<td>0.25</td>
<td>0.37</td>
</tr>
</tbody>
</table>
Table 19. Continued page 2 of 4

<table>
<thead>
<tr>
<th></th>
<th>Stature</th>
<th>Stature</th>
<th>Stature</th>
<th>Stature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1591.6</td>
<td>1653.2</td>
<td>1714.8</td>
<td>1776.4</td>
</tr>
<tr>
<td><strong>Sleeve Outseam</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>6.13</td>
<td>6.52</td>
<td>6.91</td>
<td>7.30</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>7.51</td>
<td>7.90</td>
<td>8.29</td>
<td>8.69</td>
</tr>
<tr>
<td>1120</td>
<td>8.89</td>
<td>9.29</td>
<td>9.68</td>
<td>10.07</td>
</tr>
<tr>
<td>1175</td>
<td>10.28</td>
<td>10.67</td>
<td>11.06</td>
<td>11.45</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>-191.29</td>
<td>-181.98</td>
<td>-172.68</td>
<td>-163.37</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>-164.77</td>
<td>-155.46</td>
<td>-146.15</td>
<td>-136.85</td>
</tr>
<tr>
<td>1120</td>
<td>-138.25</td>
<td>-128.94</td>
<td>-119.63</td>
<td>-110.33</td>
</tr>
<tr>
<td>1175</td>
<td>-111.72</td>
<td>-102.42</td>
<td>-93.11</td>
<td>-83.80</td>
</tr>
<tr>
<td><strong>Sitting Height</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>3.05</td>
<td>-0.31</td>
<td>-3.68</td>
<td>-7.05</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>4.37</td>
<td>1.01</td>
<td>-2.36</td>
<td>-5.73</td>
</tr>
<tr>
<td>1120</td>
<td>5.69</td>
<td>2.33</td>
<td>-1.04</td>
<td>-4.41</td>
</tr>
<tr>
<td>1175</td>
<td>7.01</td>
<td>3.65</td>
<td>0.28</td>
<td>-3.09</td>
</tr>
<tr>
<td><strong>Knee Height, Sitting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>-5.79</td>
<td>-9.58</td>
<td>-1.90</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>-5.85</td>
<td>-3.91</td>
<td>-1.96</td>
<td>-0.02</td>
</tr>
<tr>
<td>1120</td>
<td>-5.92</td>
<td>-3.97</td>
<td>-2.03</td>
<td>-0.08</td>
</tr>
<tr>
<td>1175</td>
<td>-5.98</td>
<td>-4.03</td>
<td>-2.09</td>
<td>-0.14</td>
</tr>
<tr>
<td><strong>Hip Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>-97.31</td>
<td>-99.02</td>
<td>-100.72</td>
<td>-102.43</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>-96.67</td>
<td>-98.37</td>
<td>-100.08</td>
<td>-101.79</td>
</tr>
<tr>
<td>1120</td>
<td>-96.03</td>
<td>-97.73</td>
<td>-99.44</td>
<td>-101.15</td>
</tr>
<tr>
<td>1175</td>
<td>-95.38</td>
<td>-97.09</td>
<td>-98.80</td>
<td>-100.51</td>
</tr>
</tbody>
</table>
Table 19. Continued page 3 of 4

<table>
<thead>
<tr>
<th>Stature</th>
<th>1591.6</th>
<th>1653.2</th>
<th>1714.8</th>
<th>1776.4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biceps Circ, Flexed</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>7.35</td>
<td>6.55</td>
<td>5.76</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>9.05</td>
<td>8.25</td>
<td>7.45</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>10.75</td>
<td>9.95</td>
<td>9.15</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>12.45</td>
<td>11.65</td>
<td>10.85</td>
</tr>
<tr>
<td><strong>Waist Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>-25.09</td>
<td>-18.89</td>
<td>-12.69</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>-23.32</td>
<td>-17.12</td>
<td>-10.91</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>-19.77</td>
<td>-13.57</td>
<td>-7.37</td>
</tr>
<tr>
<td><strong>Back Arc, Bust</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>-13.96</td>
<td>-12.61</td>
<td>-11.26</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>-14.53</td>
<td>-13.18</td>
<td>-11.82</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>-15.66</td>
<td>-14.30</td>
<td>-12.95</td>
</tr>
<tr>
<td><strong>Interscye Front</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>7.03</td>
<td>7.11</td>
<td>7.19</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>8.05</td>
<td>8.13</td>
<td>8.21</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>9.07</td>
<td>9.15</td>
<td>9.23</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>10.08</td>
<td>10.16</td>
<td>10.24</td>
</tr>
<tr>
<td><strong>Bust Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>-51.37</td>
<td>-50.68</td>
<td>-49.99</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>-52.88</td>
<td>-52.19</td>
<td>-51.50</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>-54.39</td>
<td>-53.70</td>
<td>-53.01</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>-55.91</td>
<td>-55.22</td>
<td>-54.53</td>
</tr>
<tr>
<td>Stature</td>
<td>1591.6</td>
<td>1653.2</td>
<td>1714.8</td>
<td>1776.4</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>Ankle Circumference</td>
<td>1009</td>
<td>-11.43</td>
<td>-10.57</td>
<td>-9.72</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>-8.92</td>
<td>-8.07</td>
<td>-7.22</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>-6.41</td>
<td>-5.56</td>
<td>-4.71</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>-3.91</td>
<td>-3.06</td>
<td>-2.21</td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>13.49</td>
<td>12.33</td>
<td>11.17</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>19.56</td>
<td>18.41</td>
<td>17.25</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>25.64</td>
<td>24.48</td>
<td>23.32</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>31.71</td>
<td>30.56</td>
<td>29.40</td>
</tr>
<tr>
<td>Waist Back Length</td>
<td>1591.6</td>
<td>1653.2</td>
<td>1714.8</td>
<td>1776.4</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>-13.71</td>
<td>-10.32</td>
<td>-6.92</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>-12.26</td>
<td>-8.86</td>
<td>-5.47</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>-10.81</td>
<td>-7.41</td>
<td>-4.02</td>
</tr>
</tbody>
</table>
Table 20. Estimated Male minus Female Computed Values with Shoulder and Hip Circumferences as Dependent Variables

<table>
<thead>
<tr>
<th>Shoulder Circumference</th>
<th>Axilla Height</th>
<th>898</th>
<th>958</th>
<th>1018</th>
<th>1078</th>
</tr>
</thead>
<tbody>
<tr>
<td>1009</td>
<td>83.64</td>
<td>95.82</td>
<td>108.00</td>
<td>120.18</td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>70.40</td>
<td>82.58</td>
<td>94.76</td>
<td>106.94</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>57.16</td>
<td>69.34</td>
<td>81.52</td>
<td>93.70</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>43.92</td>
<td>56.10</td>
<td>68.28</td>
<td>80.46</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shoulder Circumference</th>
<th>Waist Height</th>
<th>898</th>
<th>958</th>
<th>1018</th>
<th>1078</th>
</tr>
</thead>
<tbody>
<tr>
<td>1009</td>
<td>-33.02</td>
<td>-26.24</td>
<td>-19.46</td>
<td>-12.68</td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>-43.83</td>
<td>-37.05</td>
<td>-30.27</td>
<td>-23.49</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>-54.65</td>
<td>-47.87</td>
<td>-41.09</td>
<td>-34.31</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>-65.46</td>
<td>-58.68</td>
<td>-51.90</td>
<td>-45.12</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shoulder Circumference</th>
<th>Bustpoint Height</th>
<th>898</th>
<th>958</th>
<th>1018</th>
<th>1078</th>
</tr>
</thead>
<tbody>
<tr>
<td>1009</td>
<td>90.91</td>
<td>99.42</td>
<td>107.93</td>
<td>116.44</td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>81.57</td>
<td>90.07</td>
<td>98.58</td>
<td>107.09</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>72.22</td>
<td>80.73</td>
<td>89.24</td>
<td>97.74</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>62.87</td>
<td>71.38</td>
<td>79.89</td>
<td>88.40</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shoulder Circumference</th>
<th>Buttock Height</th>
<th>898</th>
<th>958</th>
<th>1018</th>
<th>1078</th>
</tr>
</thead>
<tbody>
<tr>
<td>1009</td>
<td>53.63</td>
<td>61.33</td>
<td>69.03</td>
<td>76.74</td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>41.78</td>
<td>49.49</td>
<td>57.19</td>
<td>64.89</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>29.94</td>
<td>37.64</td>
<td>45.34</td>
<td>53.04</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>18.09</td>
<td>25.79</td>
<td>33.49</td>
<td>41.20</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shoulder Circumference</th>
<th>Sleeve Inseam</th>
<th>898</th>
<th>958</th>
<th>1018</th>
<th>1078</th>
</tr>
</thead>
<tbody>
<tr>
<td>1009</td>
<td>29.06</td>
<td>33.04</td>
<td>37.03</td>
<td>41.01</td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>25.46</td>
<td>29.45</td>
<td>33.43</td>
<td>37.42</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>21.87</td>
<td>25.85</td>
<td>29.84</td>
<td>33.82</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>18.27</td>
<td>22.26</td>
<td>26.24</td>
<td>30.23</td>
<td></td>
</tr>
<tr>
<td></td>
<td>898</td>
<td>958</td>
<td>1018</td>
<td>1078</td>
<td></td>
</tr>
<tr>
<td>-------------------------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td><strong>Hip Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sleeve Outseam</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hip Circumference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>43.79</td>
<td>52.36</td>
<td>60.93</td>
<td>69.50</td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>38.09</td>
<td>46.66</td>
<td>55.23</td>
<td>63.86</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>32.40</td>
<td>40.96</td>
<td>49.53</td>
<td>58.10</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>26.70</td>
<td>35.27</td>
<td>43.84</td>
<td>52.41</td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>74.77</td>
<td>137.36</td>
<td>199.96</td>
<td>262.55</td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>55.49</td>
<td>118.08</td>
<td>180.68</td>
<td>243.28</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>36.21</td>
<td>98.81</td>
<td>161.40</td>
<td>224.00</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>16.94</td>
<td>79.53</td>
<td>142.13</td>
<td>204.72</td>
<td></td>
</tr>
<tr>
<td><strong>Sitting Height</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>43.21</td>
<td>44.79</td>
<td>46.38</td>
<td>47.96</td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>41.41</td>
<td>42.99</td>
<td>44.57</td>
<td>46.15</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>39.60</td>
<td>41.18</td>
<td>42.76</td>
<td>44.35</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>37.79</td>
<td>39.38</td>
<td>40.96</td>
<td>42.54</td>
<td></td>
</tr>
<tr>
<td><strong>Knee Height, Sitting</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>36.17</td>
<td>52.99</td>
<td>54.77</td>
<td>64.08</td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>29.04</td>
<td>38.34</td>
<td>47.64</td>
<td>56.95</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>21.91</td>
<td>31.21</td>
<td>40.52</td>
<td>49.82</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>14.78</td>
<td>24.08</td>
<td>33.39</td>
<td>42.69</td>
<td></td>
</tr>
<tr>
<td><strong>Stature</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>107.68</td>
<td>119.43</td>
<td>131.18</td>
<td>142.94</td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>96.91</td>
<td>108.67</td>
<td>120.42</td>
<td>132.17</td>
<td></td>
</tr>
<tr>
<td>1120</td>
<td>86.15</td>
<td>97.90</td>
<td>109.66</td>
<td>121.41</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>75.38</td>
<td>87.14</td>
<td>98.89</td>
<td>110.65</td>
<td></td>
</tr>
<tr>
<td></td>
<td>898</td>
<td>958</td>
<td>1018</td>
<td>1078</td>
<td></td>
</tr>
<tr>
<td>------------------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
<td></td>
</tr>
<tr>
<td><strong>Biceps Circ, Flexed</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>15.74</td>
<td>14.48</td>
<td>13.22</td>
<td>11.97</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>18.21</td>
<td>16.95</td>
<td>15.70</td>
<td>14.44</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>20.68</td>
<td>19.43</td>
<td>18.17</td>
<td>16.91</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>23.15</td>
<td>21.90</td>
<td>20.64</td>
<td>19.38</td>
</tr>
<tr>
<td><strong>Hip Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Waist Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>33.93</td>
<td>77.96</td>
<td>122.00</td>
<td>166.03</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>4.25</td>
<td>48.28</td>
<td>92.31</td>
<td>136.34</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>-25.44</td>
<td>18.59</td>
<td>62.62</td>
<td>106.65</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>-55.13</td>
<td>-11.10</td>
<td>32.93</td>
<td>76.96</td>
</tr>
<tr>
<td><strong>Hip Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Back Arc, Bust</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>-2.51</td>
<td>2.50</td>
<td>7.52</td>
<td>12.54</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>-6.39</td>
<td>-1.37</td>
<td>3.65</td>
<td>8.67</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>-10.26</td>
<td>-5.24</td>
<td>-0.22</td>
<td>4.80</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>-14.13</td>
<td>-9.11</td>
<td>-4.10</td>
<td>0.92</td>
</tr>
<tr>
<td><strong>Hip Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Interscye Front</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>13.98</td>
<td>15.69</td>
<td>17.40</td>
<td>19.11</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>13.60</td>
<td>15.31</td>
<td>17.02</td>
<td>18.73</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>13.22</td>
<td>14.93</td>
<td>16.64</td>
<td>18.36</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>12.85</td>
<td>14.56</td>
<td>16.27</td>
<td>17.98</td>
</tr>
<tr>
<td><strong>Hip Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Bust Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoulder Circumference</td>
<td>1009</td>
<td>5.02</td>
<td>14.17</td>
<td>23.32</td>
<td>32.47</td>
</tr>
<tr>
<td></td>
<td>1064</td>
<td>-1.27</td>
<td>7.88</td>
<td>17.03</td>
<td>26.18</td>
</tr>
<tr>
<td></td>
<td>1120</td>
<td>-7.57</td>
<td>1.58</td>
<td>10.73</td>
<td>19.88</td>
</tr>
<tr>
<td></td>
<td>1175</td>
<td>-13.86</td>
<td>-4.71</td>
<td>4.44</td>
<td>13.58</td>
</tr>
</tbody>
</table>
Table 20. Continued page 4 of 4

<table>
<thead>
<tr>
<th></th>
<th>898</th>
<th>958</th>
<th>1018</th>
<th>1078</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hip Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ankle Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>2.86</td>
<td>5.84</td>
<td>8.83</td>
<td>11.81</td>
</tr>
<tr>
<td>1064</td>
<td>3.30</td>
<td>6.28</td>
<td>9.27</td>
<td>12.25</td>
</tr>
<tr>
<td>1120</td>
<td>3.74</td>
<td>6.73</td>
<td>9.71</td>
<td>12.69</td>
</tr>
<tr>
<td>1175</td>
<td>4.18</td>
<td>7.17</td>
<td>10.15</td>
<td>13.13</td>
</tr>
<tr>
<td><strong>Shoulder Circumference</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1064</td>
<td>3.30</td>
<td>6.28</td>
<td>9.27</td>
<td>12.25</td>
</tr>
<tr>
<td>1120</td>
<td>3.74</td>
<td>6.73</td>
<td>9.71</td>
<td>12.69</td>
</tr>
<tr>
<td>1175</td>
<td>4.18</td>
<td>7.17</td>
<td>10.15</td>
<td>13.13</td>
</tr>
<tr>
<td><strong>Waist Back Length</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>36.99</td>
<td>48.22</td>
<td>59.45</td>
<td>70.68</td>
</tr>
<tr>
<td>1064</td>
<td>33.66</td>
<td>44.88</td>
<td>56.11</td>
<td>67.34</td>
</tr>
<tr>
<td>1120</td>
<td>30.32</td>
<td>41.55</td>
<td>52.77</td>
<td>64.00</td>
</tr>
<tr>
<td>1175</td>
<td>26.98</td>
<td>38.21</td>
<td>49.44</td>
<td>60.67</td>
</tr>
<tr>
<td><strong>Back Arc, Waist</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1009</td>
<td>13.64</td>
<td>37.15</td>
<td>60.67</td>
<td>84.18</td>
</tr>
<tr>
<td>1064</td>
<td>-1.67</td>
<td>21.84</td>
<td>45.35</td>
<td>68.87</td>
</tr>
<tr>
<td>1120</td>
<td>-16.98</td>
<td>6.53</td>
<td>30.04</td>
<td>53.56</td>
</tr>
<tr>
<td>1175</td>
<td>-32.30</td>
<td>-8.78</td>
<td>14.73</td>
<td>38.24</td>
</tr>
</tbody>
</table>

83