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**THE "AVERAGE MAN"?**

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AERO MEDICAL LABORATORY

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WRIGHT AIR DEVELOPMENT CENTER

TECHNICAL NOTE VCRD 53-7

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*Gilbert S. Daniels, 1st Lt, USAF (MSC)  
Aero Medical Laboratory*

*December 1952*

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Wright Air Development Center  
Air Research and Development Command  
United States Air Force  
Wright-Patterson Air Force Base, Ohio

## FOREWORD

This Technical Note was prepared from statistics compiled by Antioch College, Yellow Springs, Ohio under AF Contract No. 18(600)-30. Research and Development Order No. 695-71, "USAF Personnel Body Anthropometry," is the applicable project and 1st Lt Gilbert S. Daniels, USAF (MSC), the project scientist.

Sincere acknowledgment is made to Mr. Edmund Churchill of Antioch College who compiled and prepared the appendix of this report.

## INTRODUCTION

The tendency to think in terms of the "average man" is a pitfall into which many persons blunder when attempting to apply human body size data to design problems. Actually it is virtually impossible to find an "average man" in the Air Force population. This is not because of any unique traits of this group of men, but because of the great variability of bodily dimensions which is characteristic of all men. It is the intent of this Technical Note to point out and explain some of the factors that lead to the difficulties arising from the use of "average" dimensions and to indicate to some extent how they may be avoided.

The data on which this Technical Note is based are the results of the Air Force Anthropometric Survey of 1950. There is, however, every reason to suppose that conclusions similar to those reported here would have been reached if the same type of analysis had been applied to body size data based on almost any group of people.

## THE " AVERAGE MAN"

The "Average Man" is a very prominent figure. As a general rule he is used as an oversimplified means of describing the combined characteristics of a varied population. Thus we are presented with an "average man" who is about 5 feet 9 inches tall although the population he represents may vary from under 5 feet to over 6 feet 6 inches in stature. Clearly, if we were to use the 5 foot 8 inch dimension for the design of an opening such as a doorway, we would have a door through which the "average man", and indeed all of the people who are shorter than average, could pass unobstructed. The taller people, however, and these would represent about 50% of the total population, would have to stoop to avoid hitting their heads on top of the doorway. Obvious as this example may be, it does illustrate that design problems require the application of human dimensional data beyond the oversimplified and inadequate dimensions of the "average man".

Data published (1) by or available through the Anthropology Section of the Aero Medical Laboratory make available the information needed by the project engineer or scientist for the design of items where human dimensions are of importance. These data extend the description of a particular dimension beyond the average and thereby make it possible to select a suitable range of the dimension as it occurs in the total population. Such a range may, of course, be limited to serve the particular project in question. Thus if stature is being considered, a range of from 5 feet 5 inches to 6 feet 1 inch is shown to cover 90% of the Air Force population, the range having been trimmed to leave out the tallest 5% and shortest 5% of the men. If this information is used to design a doorway adequate for men 6 foot 1 inch in stature, 95% of the total using group will be able to pass through the doorway without hitting their heads.

While the use of average dimensions is generally unsatisfactory even when only one dimension is being considered at a time, the inadequacy of the "average man" method is compounded many times when more than one dimension is to be considered in a design problem. As an abstract representation of a mythical individual most representative of a given population, the "average man" is convenient to grasp in our minds. Unfortunately he doesn't exist. Instead of being the easiest individual of a group to provide for, and the most common, the "average man" is in reality a very rare specimen and very hard to fit.

The fallacy of the "average man" concept is further illustrated by a study based on body measurements made on over 4,000 Air Force flying personnel. From a total of 131 available measurements a smaller group, all useful in clothing design was selected. (Measurements applicable to other problems such as cockpit layout or seat design could equally well have been chosen; they would have given much the same results). The records of the 4,000-plus men were then examined to see how many of these men, if any, could be considered average in all of the selected measurements.

The exact method of deriving this range is discussed in detail in the Appendix but for our immediate purpose it is sufficient to state that it includes approximately the middle 30% of the total population. This is considerably more generous portion of the group than is included by the average value. In an attempt to find an "average man", the "approximately average" ranges of each measurement were used as hurdles in a step-by-step elimination. When the full sample of 4063 men was examined for stature only 1055 fell within the acceptable range of "approximately average". This group of 1055 was then culled for all of the men of "average" stature who also had "average" chest circumference. Only 302 of the group still remained. Elimination was continued with additional "average" dimensions until at the end of 10 steps there was not a single individual remaining who fell within the "average" range for all measurements. This process of elimination progressed as follows:

1. of the original 4063 men  
1055 were of approximately average stature
2. of these 1055 men  
302 were also of approximately average chest circumference
3. of these 302 men  
143 were also of approximately average sleeve length
4. of these 143 men  
73 were also of approximately average crotch height
5. of these 73 men  
28 were also of approximately average torso circumference
6. of these 28 men  
12 were also of approximately average hip circumference
7. of these 12 men  
6 were also of approximately average neck circumference
8. of these 6 men  
3 were also of approximately average waist circumference
9. of these 3 men  
2 were also of approximately average thigh circumference
10. of these 2 men  
0 were also of approximately average in crotch length

As a further step, 100 measurements made on one of the two men remaining after the ninth step were examined. Of these only 62 fell within the range of the middle 40% of the total population; 29 were smaller (below the 40th percentile) and 9 were decidedly high (above the 70th percentile). A large group of measurements made on the other of these two "most nearly average" men showed much the same pattern.

The exact method of deriving this range is discussed in detail in the Appendix but for our immediate purpose it is sufficient to state that it includes approximately the middle 30% of the total population. This is a considerably more generous portion of the group than is included by the exact average value. In an attempt to find an "average man", the "approximately average" ranges of each measurement were used as hurdles in a step-by-step elimination. When the full sample of 4063 men was examined for stature, only 1055 fell within the acceptable range of "approximately average". This group of 1055 was then culled for all of the men of "average" stature who also had "average" chest circumference. Only 302 of the group still qualified. Elimination was continued with additional "average" dimensions until at the end of 10 steps there was not a single individual remaining who fell within the "average" range for all measurements. This process of elimination progressed as follows:

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Thus it can be seen that the "average man" is a misleading and illusory concept as a basis for design criteria, and is particularly so when more than one dimension is being considered.

This Technical Note is not meant to discourage the project scientist, however, but merely to point out that the "average man" is usually not the solution to the design problem. Data are available which give a far more accurate description of range of human variability in body dimensions. A report is in progress (2) which fully describes each of 131 separate measurements of the Air Force flying population. While not yet available in published form, the data of this report are available through the Anthropology Section, Aero Medical Laboratory, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, for use by government agencies and authorized contractors. In addition, the Section can make available dimensional design criteria for cases where more than one dimension is being considered at a time. These multidimensional descriptions cannot be published in advance since each one is a separate problem in itself and the number of such combinations of measurements approaches the infinite. For the benefit of project engineers whose problems are in the multidimensional category, custom-designed solutions are available through the Anthropology Section, WCRDE-2, (Telephone 2-3230).

#### PUBLICATION REVIEW

This report has been review and is approved.

FOR THE COMMANDING GENERAL:

  
ROBERT H. BLOUNT  
Colonel, USAF (MC)  
Chief, Aero Medical Laboratory  
Directorate of Research

## APPENDIX

### Method of Deriving "Approximate Average"

Any definition of the "approximate average" is necessarily arbitrary. The statistical average of a measurement is so narrow in range that theoretically it includes only those individuals whose measurement is exactly the same as the mean value. In practice this is expanded to include those individuals who fall within the same class interval as the mean value. For instance, since stature is tabulated in 1 centimeter intervals, all of those individuals who are within plus and minus one half centimeter of the mean value would be considered average. This range would include less than 6.4% of the total group and is far too restricting for actual application of data. For the present purpose we have defined "average" more liberally to include all individuals who fall within a range of plus or minus three-tenths of a standard deviation of the mean value. This definition seems reasonable on two counts:

1. It results in the middle 25 or 30% of a group being classified as approximately average on any one measurement.
2. It provides for most measurements a value range which is at least the equivalent of a full clothing size (over  $1\frac{1}{2}$  inches on chest circumference, over 1 inch for sleeve length, etc.)

Actually it was necessary to use limits which were slightly different and, in general, slightly wider than those just described because of the form in which the data were available. The limits were set to the nearest whole value of measurement, i.e., the nearest whole centimeter.

Table I gives, for each of the measurements used in this study, the values of the mean and the standard deviation, the range of values taken to be approximately average, and the number of men who fell within this range. Full descriptions of these measurements and of the men included in the sample population can be found in WADC Technical Report 52-321 "Anthropometry of Flying Personnel-1950" (2).

TABLE I

<u>Measurement</u>	<u>Mean</u>	<u>Std. Dev.</u>	<u>Range of "Average"</u>	<u>*N for Range of "Average"</u>
Stature	175.5 cm	6.2 cm	173.95-177.95 cm	1055
Chest Circumference	98.6 cm	6.2 cm	96.95-100.95 cm	1023
Sleeve Length	85.5 cm	3.8 cm	83.95-86.95 cm	1253
Crotch Height	83.4 cm	4.4 cm	81.95-84.95 cm	1105
Vertical Trunk Circ.	164.6 cm	7.3 cm	162.95-166.95 cm	1093
Hip Circumference (Sit.)	105.0 cm	7.2 cm	103.95-108.95 cm	1113
Neck Circumference	38.0 cm	1.9 cm	36.95- 38.95 cm	1713
Waist Circumference	81.4 cm	7.7 cm	78.95- 83.95 cm	990
Thigh Circumference	56.9 cm	4.4 cm	54.95- 57.95 cm	1114
Crotch Length	71.6 cm	5.1 cm	69.95- 72.95 cm	1008

• Based on the original group of 4,063 men.

## BIBLIOGRAPHY

1. AF Technical Report 5501 Human Body Size in Military Aircraft and Personal Equipment. AF, AMC, Wright Field, Dayton, Ohio (Unclassified)
2. WADC Technical Report 52-321, Anthropometry of Flying Personnel, 1950, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio. (Unclassified) (In preparation)