# ANTHROPOMETRIC SURVEY OF THE IMPERIAL IRANIAN ARMED FORCES Phase III TECHNICAL SUMMARY

1971

# COMBAT BOOT STUDY PROJECT IMPERIAL IRANIAN ARMED FORCES TECHNICAL SUMMARY



UNITED STATES ARMY
NATICK LABORATORIES
Natick, Massachusetts 01760

# ANTHROPOMETRIC SURVEY
# OF THE
# IMPERIAL IRANIAN ARMED FORCES

## PHASE III

## TECHNICAL SUMMARY

by

Stephen J. Kennedy, Ph.D.
Robert M. White

May 1971

# FOREWORD

This Technical Summary combines a report on Phase III of the Anthropometric Survey of the Imperial Iranian Armed Forces and the report on the Combat Boot Study Project which also involves application of the anthropometric data obtained in the first two phases of the Imperial Iranian Armed Forces Anthropometric Survey.

In accordance with a request made by IIADF, , an anthropometric survey was undertaken by the Combat Research and Evaluation Center at the direction of the Vice Chief of the Supreme Commander's Staff, Lt. General Fereidum Djam. The main objective of the survey was to provide the Imperial Iranian Armed Forces a basis for determining how to improve their uniforms and tariffs.

The collection of data for this program, undertaken by CREC in consultation with the Research Triangle Institute as part of an ARPA program, was completed in 1969.

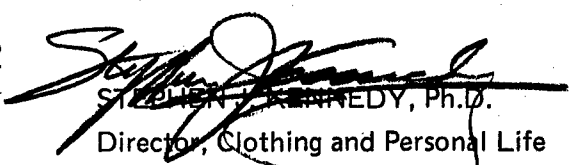
The application of anthropometric data is a highly complex task involving the generation of patterns in the case of clothing, and footwear lasts in the case of boots. Because of similarities in body proportions and other common aspects of anthropometric data which had been established by anthropometrists in the past 25 years, it was apparent that there was a good chance that a relationship could be established between the anthropometric measurements of IIADF and U.S. military personnel, which could make possible the utilization of U.S. experience in the development of patterns and lasts without the need for initiation of totally new projects.

Preliminary examination of IIADF data indicated that such correlation was possible. This was pointed out by the undersigned upon his visit to Iran 9 - 20 April 1971, to representatives both of ARMISH-MAAG and the IIADF.

It was stated that a technical summary would be made in which the application of the anthropometric data generated in the Iranian study would be applied to patterns and lasts in a way in which this information could be used by the Imperial Iranian Armed Forces for the stated objectives. This report, accordingly, includes the technical summary on the application of the anthropometric data to uniforms and to combat footwear, with appropriate recommendations as to actions which could be taken to accomplish the original objectives of the anthropometric survey.

## FOREWORD (continued)

Special acknowledgment is made for the continuing assistance provided by Mr. Herbert W. Kress, Research Triangle Institute Field Party Chief in Tehran; to the ARPA organization for its support of this program; to Mr. Robert M. White who initiated the anthropometric study and is largely responsible for preparing the guidelines under which it was conducted and who developed the proposed tariffs; to Doctor Shoja-eddin Nourani, CREC Project Officer, who accomplished an extremely difficult task of directing the survey and obtaining the anthropometric data; to Brigadier General Boroomandan, Chief of CREC, for his understanding and support of the program; and particularly to Miss Jean Burleigh who prepared the report in final form.



STEPHEN J. KENNEDY, Ph.D.
Director, Clothing and Personal Life
Support Equipment Laboratory
U. S. Army Natick Laboratories
Natick, Massachusetts

# ANTHROPOMETRIC SURVEY OF THE IMPERIAL IRANIAN ARMED FORCES

## PHASE III

## TECHNICAL SUMMARY

## CLOTHING

## LIST OF TABLES



## LIST OF CHARTS

# ANTHROPOMETRIC SURVEY OF THE IMPERIAL IRANIAN ARMED FORCES

## PHASE III

## TECHNICAL SUMMARY

### Introduction

Anthropometric measurements are important in the development of items of uniform, footwear, headgear and handwear and the personal equipment of military forces. Their use makes possible the development of properly fitting clothing and equipment, which in turn, increases the efficiency of the troops and assists in achieving a suitable and uniform military appearance.

Anthropometric measurements can be applied to the uniforms and personal equipment of troops in three ways:

1. In the development of the patterns used in producing items of uniform, so that they will fit properly and give a smart military appearance, and still not restrict body movement. Similarly they may be used in the development of patterns of other items of personal equipment.

2. In the determination of the number of sizes required to give a satisfactory fit to the entire population of the military forces.

3. In the development of the tariffs, i.e., the quantity of each size to be produced, so as to maintain balanced stocks of the various sizes at the point of issue to troops.

The starting point in the application of anthropometric measurement is the "master pattern" from which all other sizes are to be graded.

First we must have the image of how the Chief of Staff wants his men to look. This conception of the military appearance of the armed forces is the starting point in the development of uniforms. It is also the goal of all uniform development. It expresses the desire of the nation to have its military forces reflect the image of their country with honor and dignity and to create esprit de corps by their military appearance.

The uniform of the armed forces is based primarily upon the design and color of the uniform coat, or other outer garment, the design of the headgear, and the style, color and character of the insignia and decorations that are worn on the uniform.

However, this image is also affected very greatly by the way the uniform is fitted and worn. When the uniform was designed, there was some standard "concept of fit", a conception of how the typical soldier would look when he was properly fitted in his uniform.

Uniformity in the items worn and in the manner in which they are fitted and worn is what we mean by a "uniform". Without determination to have a "uniform", i.e., to have all troops of uniform appearance in respect to the regulation items of the standard uniform and the standard concept of fit, action to try to achieve better appearance by perfecting the patterns used in the production of the uniform will be ineffective.

Throughout the world, all armies seek to portray this national image of their armed forces by insisting upon uniformity in appearance in accordance with some national standard, and then by enforcing this uniformity by disciplinary action. In this way the uniform and the manner of wearing the uniform become a useful means for achieving discipline. The two factors go hand-in-hand, i.e., enforcement of uniform regulations helps to achieve and maintain discipline, and vice versa.

## Anthropometry and Patterns for Clothing

Anthropometric measurements are applied to patterns in two ways:

1. They are used to produce the "master model" in some one size so that it fits that size of person properly in all aspects, i.e., it is balanced in respect to all body dimensions so that it fits in accordance with the approved concept of fit.

Good tailors can intuitively produce a coat, for example, that fits a given person properly in all respects. This is an expression of the art of tailoring and clothing design. The tailor's concern is only to get a suit or uniform that fits one person satisfactorily.

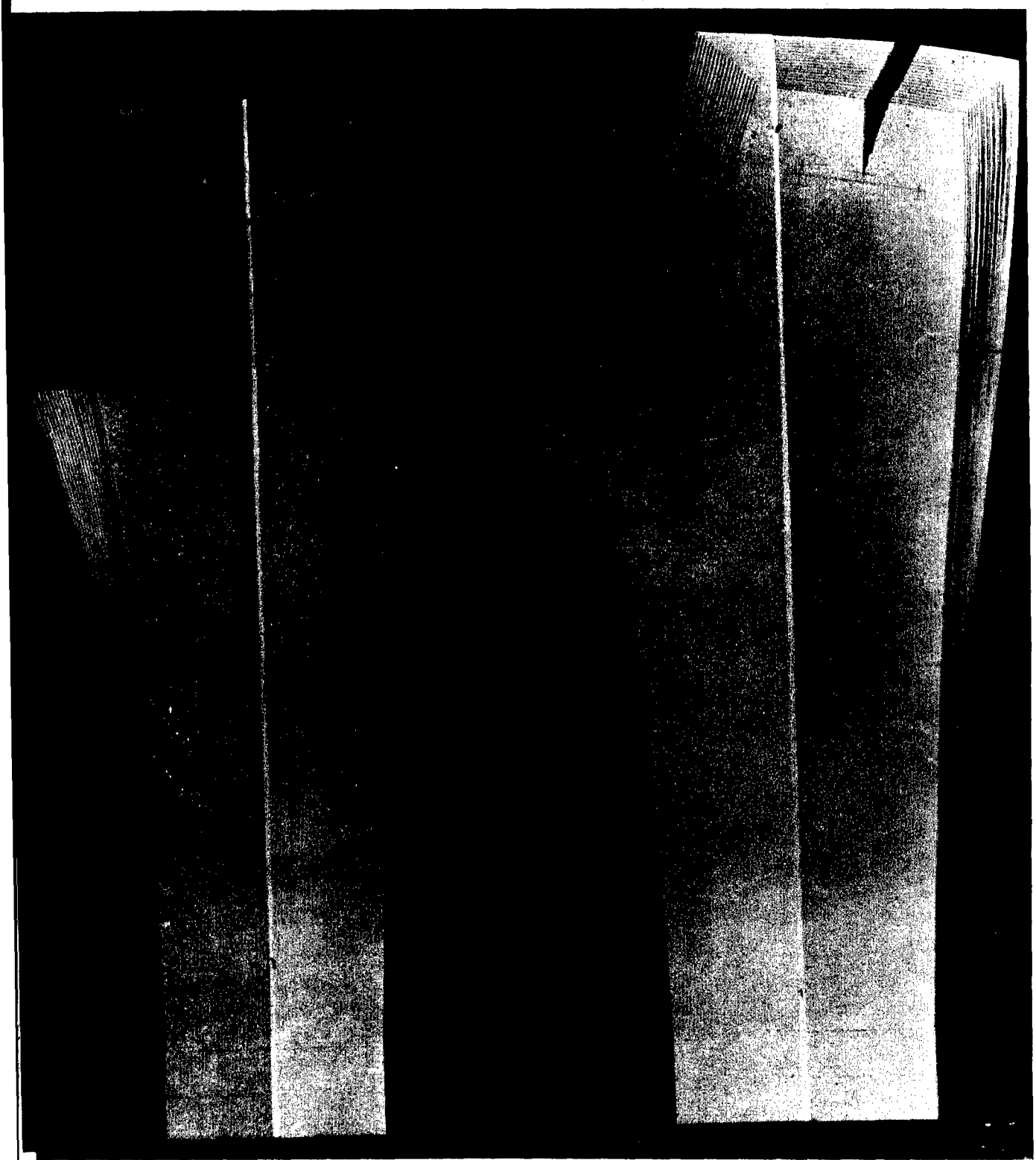
In developing a uniform, however, the concern is to get a basic pattern, which when graded in a full range of sizes will make it possible to produce uniforms that will fit the entire population as well as the master model fitted that one person for whom it was designed. If this master pattern is not proportioned correctly, distortions will be magnified in the graded patterns, so that in the other sizes, the garment will not fit correctly or will look grotesque.

Anthropometric measurements, accordingly, are useful in making the master pattern true to body dimensions.

2. Anthropometric measurements also determine the basis for grading of patterns in other sizes, so that the sizes up and down from the master model will be proportioned to the dimensions of the people over the entire population distribution.

Just as the master model must be balanced in respect to all body dimensions, the other graded sizes must also be balanced in respect to the sizes of persons they are designed to fit.

This balance is achieved by a combination of the use of anthropometric measurements and skill in pattern making. The final result is shown in the illustration of the various sizes of graded patterns for the fronts of trousers superimposed on each other, from the small sizes on the top grading to the larger sizes on the bottom. This illustration shows how the larger sizes differ from the smaller, and how all dimensions are increased to an appropriate degree as the pattern is graded up to fit larger sized men.



## Determination of the Number of Sizes Required

The number of sizes of uniforms to be provided for issue is dependent upon a number of factors:

1. First, the degree to which a smart-appearing, well-fitting uniform is desired.

This is an area where you cannot "get something for nothing." Either a uniform fits or it doesn't fit.

Years ago men's clothing stores in the United States sold suits on the basis of two-inch intervals in chest measurements. To get proper fit many of these suits had to have major shoulder alterations. Shoulder alterations are difficult to make and costly. Today all retail clothing stores sell ready-made suits on the basis of one-inch intervals in chest measurements, up to size 44, and two-inch intervals beyond that.

Similarly, shirts are sold on the basis of one-half inch intervals in neck measurements and one-inch intervals in sleeve lengths.

Trousers and slacks are sold with one-inch intervals at the waist if the bottoms of the trousers are unhemmed (wool trousers and slacks) or, if hemmed, with one-inch intervals in leg length. In this way, the stores, and ultimately, the customers are spared the cost of alterations. The objective is to make it possible for a person to walk into a store, buy a pair of trousers, for example, and walk out wearing them. This is similar to the basic concept of issuing a military uniform.

People want their clothes to fit and to look right. To accomplish this, the garment should fit correctly when it is purchased.

The U.S. Army uses a sizing system similar to that used in commercial men's clothing as sold in the United States. This makes it possible to fit our uniforms at the time of issue to at least 80% of our troops without significant alterations, if the full range of sizes is available for issue, other than the hemming of the trousers, or lengthening or shortening of sleeve lengths.

2. Second, the number of sizes which should be provided at the time of issue depends upon the extent to which alterations are to be used to achieve an acceptable fit.

As indicated above, in commercial practice, and in the U.S. Army, our objective is to avoid having to make alterations. They are costly and time-consuming. Also, there is the risk that in making alterations, the standard concept of fit will be violated.

It may be said that if the individual soldier does not feel his uniform fits correctly, he can take it to a local tailor and have it altered at his own expense to make it fit. This is wrong from every standpoint.

It is wasteful to have a high percentage of alterations which will cost much more than the cost of producing enough sizes in the first place. Also to require the soldier to use his own pay to make his uniform fit causes bad morale. It implies that the Army does not care enough about the soldier's appearance to give him a proper-fitting uniform in the first place.

However, the worst aspect is that the soldier will have the uniform altered to look the way he thinks is smart which means that he will try to have it fitted differently from the standard concept so as to show off his individuality. Or he may try to follow civilian styles. The net effect will be to destroy the uniform appearance of the Army.

3. Third, the number of sizes that may be required will depend upon the functional requirements of the uniform.

In a garrison style uniform, the functional requirements are limited to such factors as having enough room in the shoulders for the man to be able to handle his rifle properly and to salute.

In field or combat uniforms, however, looseness of fit is necessary to accommodate heavier under-layers of clothing in cold weather and to permit the full range of combat activities.

Because of these different functional requirements, most armies today have separate uniforms for service and garrison wear on the one hand, and for field or combat duty on the other. Fewer sizes can be used in field uniforms than in garrison uniforms because functionality is more important in the field uniform, whereas appearance is of primary importance in a garrison or service uniform.

4. Fourth, the number of sizes of uniforms will be dependent upon the ability of the army to support from a supply standpoint an adequate range of sizes.

From a logistic standpoint, it would appear that fewer sizes would be easier to supply than a larger number. This advantage must be weighed, however, against the total cost of having only a few sizes plus the cost of alterations, plus the cost in morale and national respect for the Army which a few sizes of poor fitting uniforms creates.

## Development of Tariffs

Anthropometric data can be and are used by many armies today also in the preparation of master tariff schedules to determine the relative quantities of different sizes of an item that should be procured. This subject will be discussed in more detail at a later point in this report.

## Comparison of IIADF Anthropometric Data with Similar Measurements for the U.S. Armed Forces

When the anthropometric data for the IIAF became available at the U.S. Army Natick Laboratories, a check was made to compare these measurements with similar measurements for the U. S. Armed Forces to see what differences might exist, or in what respects basic proportions were the same, so as to determine to what extent the same basic patterns might apply.

For this comparison, as will be brought out below, it was immediately apparent that basic proportions in the most critical measurements were the same, except that men in the U. S. Armed Forces were on the average about a size larger and had longer legs.

Table I shows certain comparative data for the average soldier in the United States Army and the corresponding average soldier in the Imperial Iranian Armed Forces, based upon the two anthropometric studies. The data are shown in terms of the 50th percentile man, i.e., the man half-way between the tallest and the shortest man.

TABLE I

Comparison of Body Dimensions of the Average American and Iranian Soldier (50th Percentile)

| | U. S. | | IIAF | |
|---|---|---|---|---|
| | Inches | Cm. | Inches | Cm. |
| Stature | 68.7 | 174.4 | 65.6 | 166.7 |
| Crotch Height | 33.0 | 83.9 | 30.2 | 76.7 |
| Chest Circumference | 36.6 | 93.0 | 35.4 | 89.9 |
| Waist Circumference | 31.0 | 89.9 | 30.2 | 76.7 |
| Neck Circumference | 14.7 | 37.3 | 14.2 | 36.2 |
| Sleeve Length | 33.8 | 85.7 | 32.3 | 82.1 |

It will be apparent that the average American soldier is somewhat taller than the average Iranian soldier. This difference in stature (height) is 3.1 inches (7.7 cm.). It will also be noted, however, that nearly all of this difference in height is in the crotch height: 2.8 inches (7.2 cm.), that is, the distance from the ground to the crotch. This means simply that the Americans have longer legs, but that otherwise their height dimensions are proportional to those of Iranian soldiers. In other words, there is not any great difference in height dimensions between men of the two armies except for this factor of the longer legs of the average American.

This particular difference presents no significant problem in the translation of anthropometric data into pattern development, since all it requires is making the trouser legs shorter. If the trouser legs are left unhemmed, and fitted at the time of issue, it presents no problem at all. If the trouser legs are hemmed before they are issued, they should be made shorter than the American patterns would furnish for the corresponding amount of the difference in leg length for the height of the man being fitted.

The comparison of chest circumference, which is another critical anthropometric measurement, shows only a slight variation from U. S. military measurements; only 1.2 inches (3.1 cm), while waist circumference is even less, just under an inch (2.2 cm). Similarly, neck circumference is just one-half inch (1.1 cm) smaller.

These three measurements taken together indicate that the average Iranian soldier would wear just about one size smaller shirt than his American counterpart, and that his basic proportions are otherwise just about the same as the U. S. soldier, except for sleeve length. Here he would use a shorter sleeve length than his American counterpart — 1.5 inches (3.6 cm). These shorter sleeves are already provided for in the U. S. pattern ranges, except for the very smallest sizes.

In respect to trousers, the problem is even simpler since the waist circumference is less than one inch smaller, and the trouser lengths could be adjusted as indicated above.

What has been said so far applies to the average size man whom we have identified as the fiftieth percentile man as taken in the anthropometric study. Before accepting these conclusions finally, we should check and see if these same relationships hold for men of other sizes. This comparison has been made in the accompanying charts (Charts II to VIII) which show comparisons between men of the two armies over the whole range of sizes from the fifth percentile to the ninety-fifth percentile.

In using these limits we have excluded the upper and lower five percent of men, who normally present a problem in fitting anyway as can be seen from the bell-shaped curve showing the statistical distribution of the stature of Iranian troops. It can be seen that there are far more people around the middle dimensions than at the two extremes of the curve. In a theoretical normal curve, the 50th percentile falls exactly in the center of the curve and is the most frequent single value. The numbers of men on either side decrease rapidly away from this 50th percentile figure. At the two extremes of the curve, as will be noted, there are actually very few people represented in the figures. For this reason in design problems based upon statistics, these extreme values are frequently excluded even though this may require the provision of special measurement clothing for such people rather than trying to make clothing for them in a normal tariff. Even in an

army as large as that of the United States, we leave these people on the fringes of the population distribution for special treatment in respect to clothing fitting (Chart I), and that would probably also be desirable in the Iranian army. In general practice, accordingly, designers attempt to accommodate only 90 percent of the population, excluding the 5 percent of the two extremes as is reflected in the curves shown in this report.

Looking at the following charts, one sees that the two lines for U. S. troops and those of the Imperial Iranian Ground Forces run essentially parallel.

Chart II, for example, which shows the relationship for stature, shows that the difference in height between the two populations is constant for all practical purposes over the whole range of heights. At the fifth percentile, the difference in height is 2.6 inches, and at the 95th percentile, it is only 3.4 inches. The average difference of 3.0 inches, which was shown above for the average man, can be accepted, accordingly, over the whole range of the military population as a general measure of this difference as it may apply to pattern development.

In Chart III can be seen the same difference in crotch height — the distance from the ground to the crotch. Here again the two curves are practically parallel, and the differences are again approximately the same throughout the entire range of the two populations.

In chest and waist circumferences, Charts IV and V, there is a slightly greater difference in the larger sizes — a half-inch each at the 5th percentile and about two inches at the 95th percentile. However, these differences present no particular problem. All they mean is that there will be fewer large sizes required in the tariff of sizes for the Iranians than for U. S. troops. Since the basic proportions do not change, the fit will be fully as satisfactory.

This is clearly brought out in the comparison of neck sizes (Chart VI) , and the dimensions for chest and waist girth as shown in Charts IV and V. In other words, the larger size men become larger proportionately in all three dimensions, retaining the same basic proportions in these three critical fitting dimensions. All that would be required would be an adjustment in the tariff of sizes.

The essential relationship of all these dimensions for U. S. and Iranian soldiers is brought out in Chart VII which shows that increases in all of these dimensions are proportional for men of all sizes in the two armies. This demonstrates clearly the ease with which,once a pattern size adjustment has been made, the patterns for the U. S. Armed Forces can be used for the clothing and uniforms of the Iranian Army.

In sleeve length (Chart VIII) the lines are again proportionately smaller throughout the size range so that all that would be needed here would be to select shirt patterns with smaller sleeves, an adjustment which could be made entirely by tariff adjustment and proper fitting.

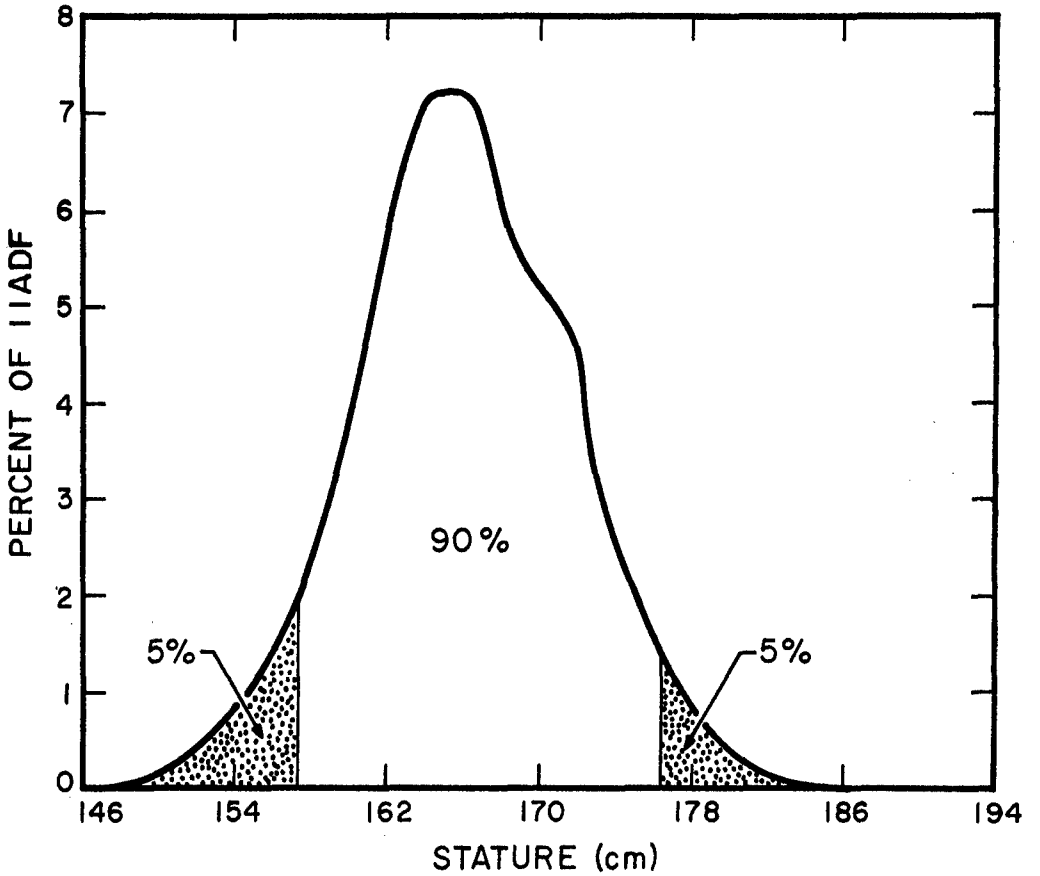



CHART I DISTRIBUTION OF STATURE OF IIADF PERSONNEL

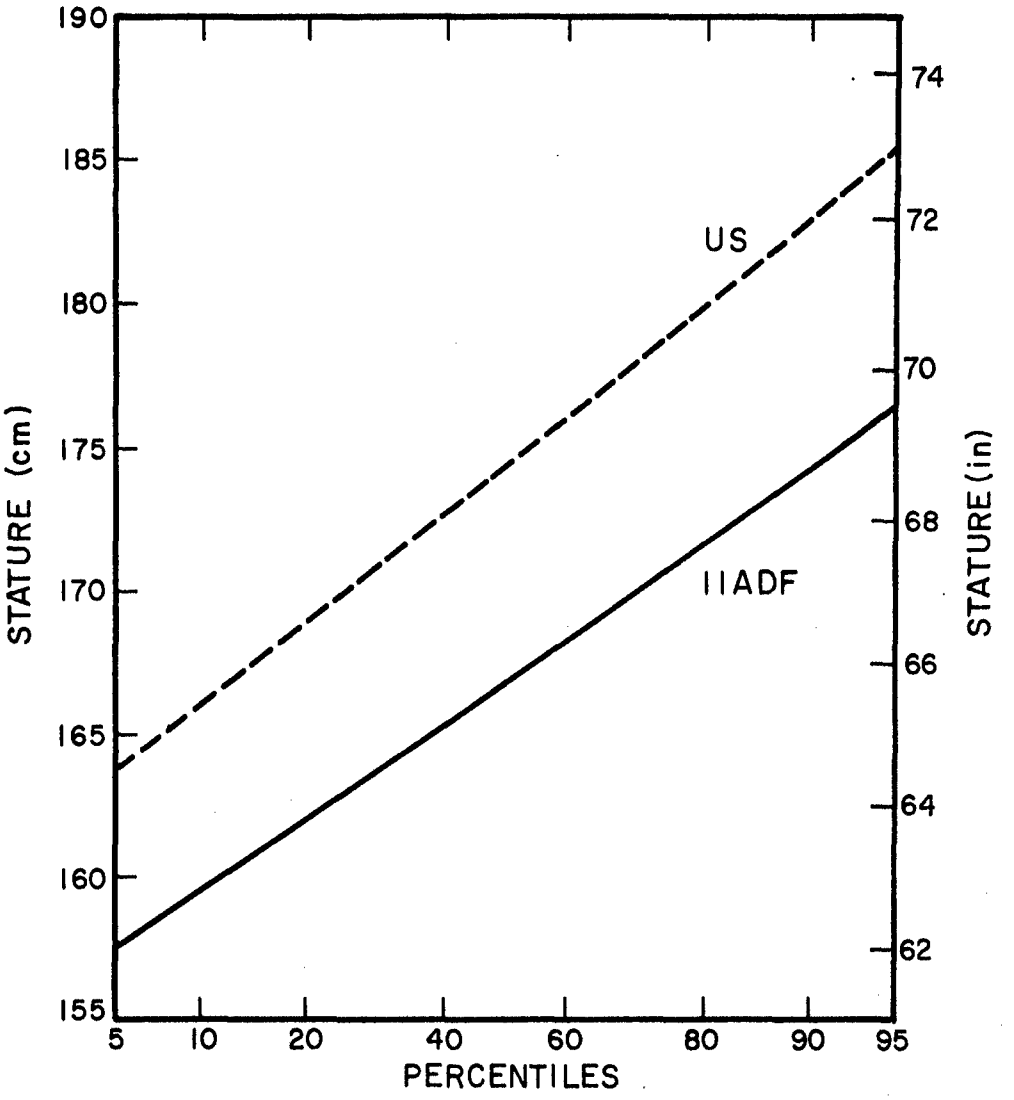



CHART II COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR STATURE (5th TO 95th PERCENTILES)

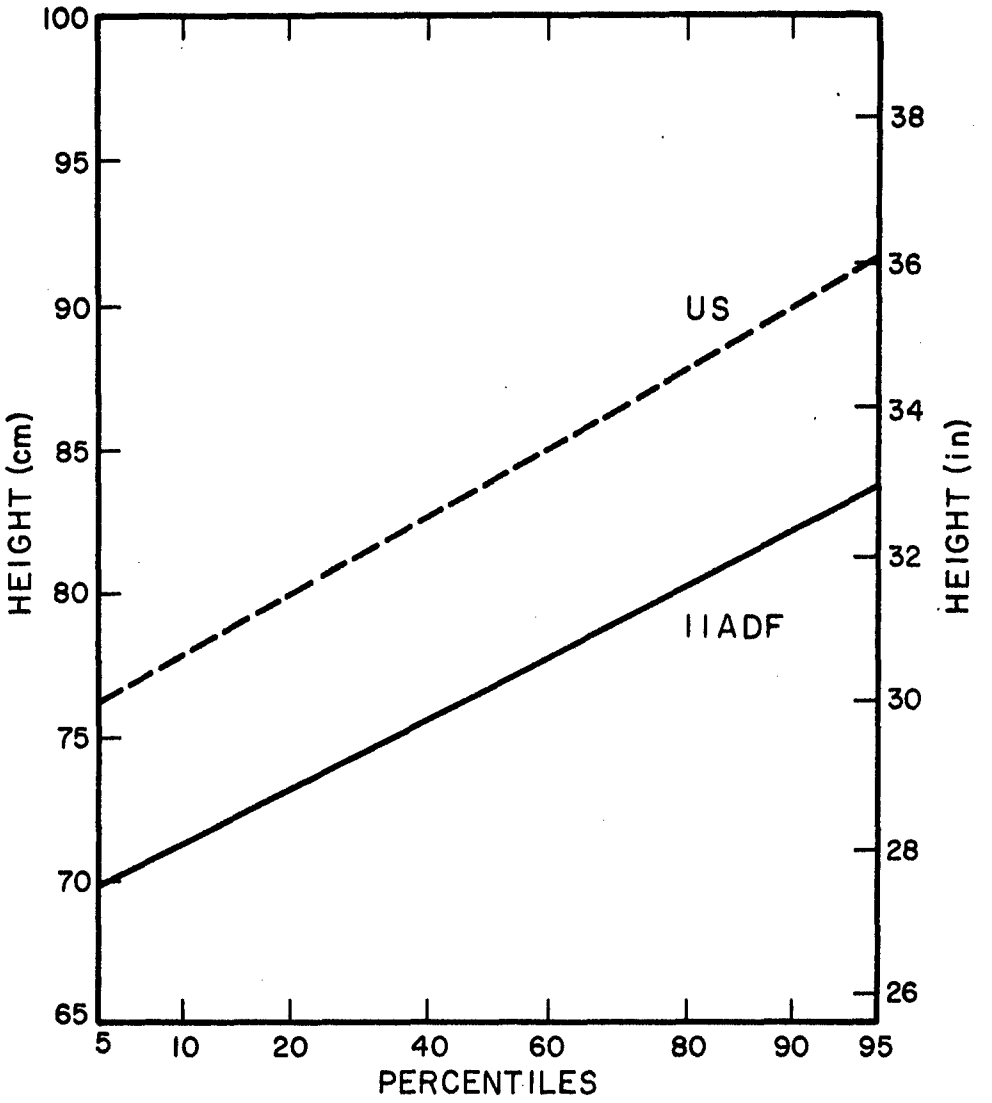



CHART III COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR CROTCH HEIGHT (5th TO 95th PERCENTILES)

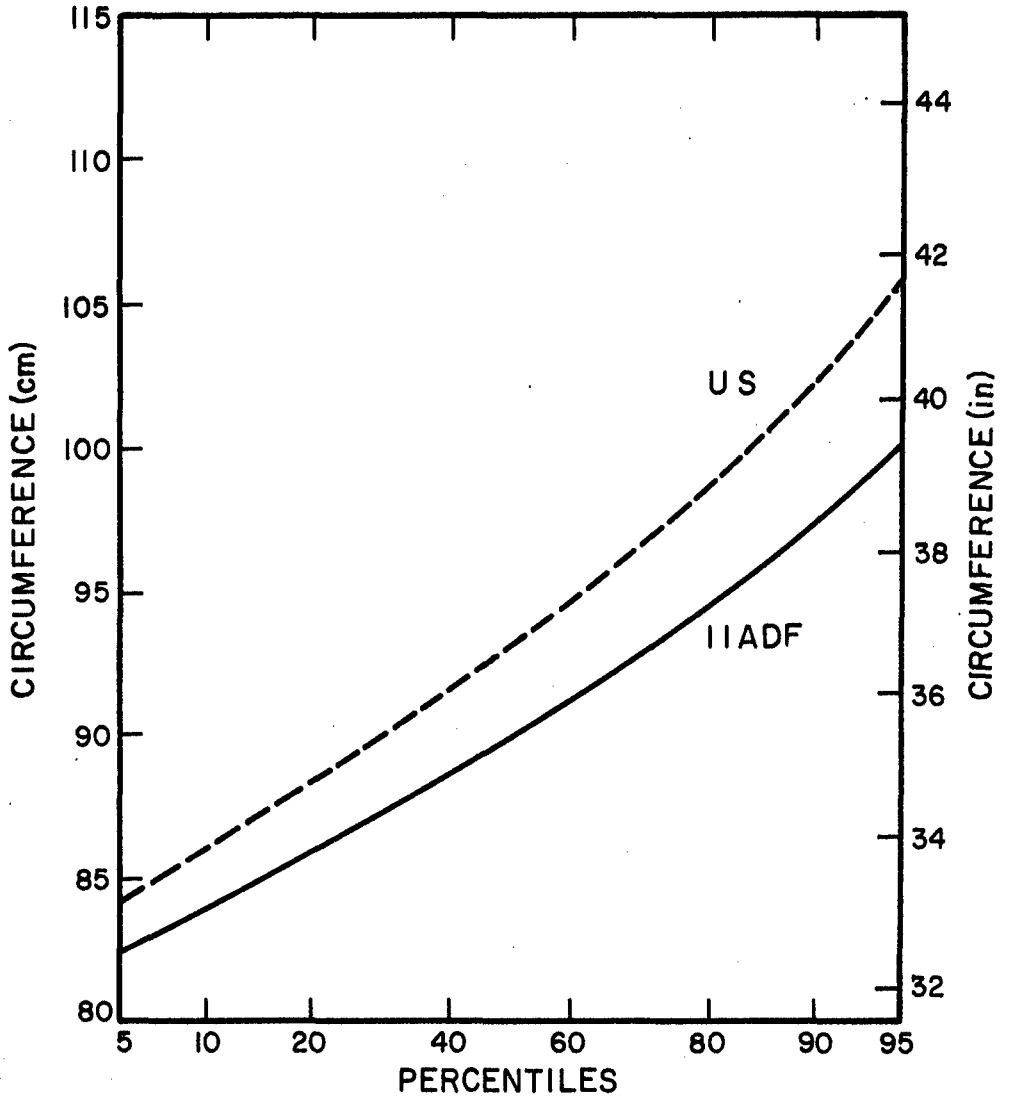



CHART IV COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR CHEST CIRCUMFERENCE (5th TO 95th PERCENTILES)

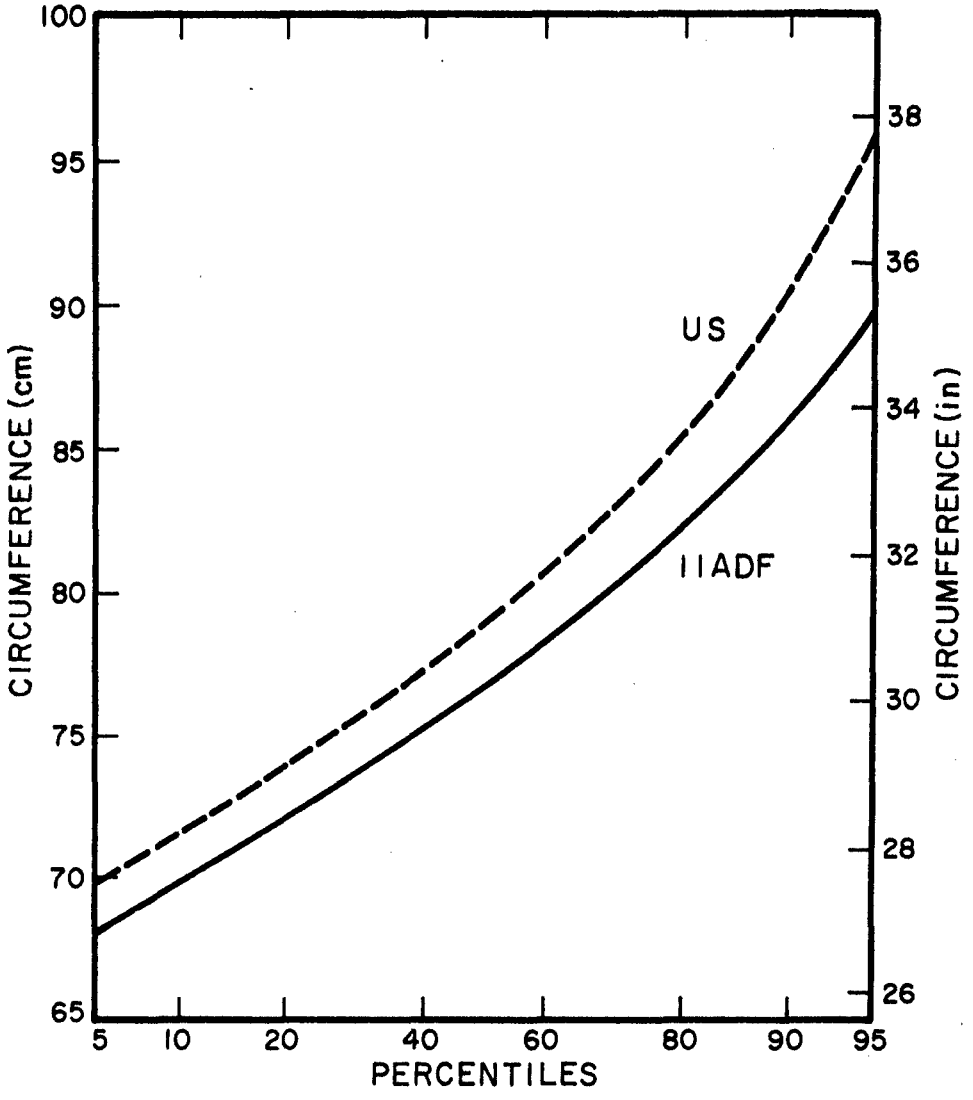



CHART V COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR WAIST CIRCUMFERENCE (5th TO 95th PERCENTILES)

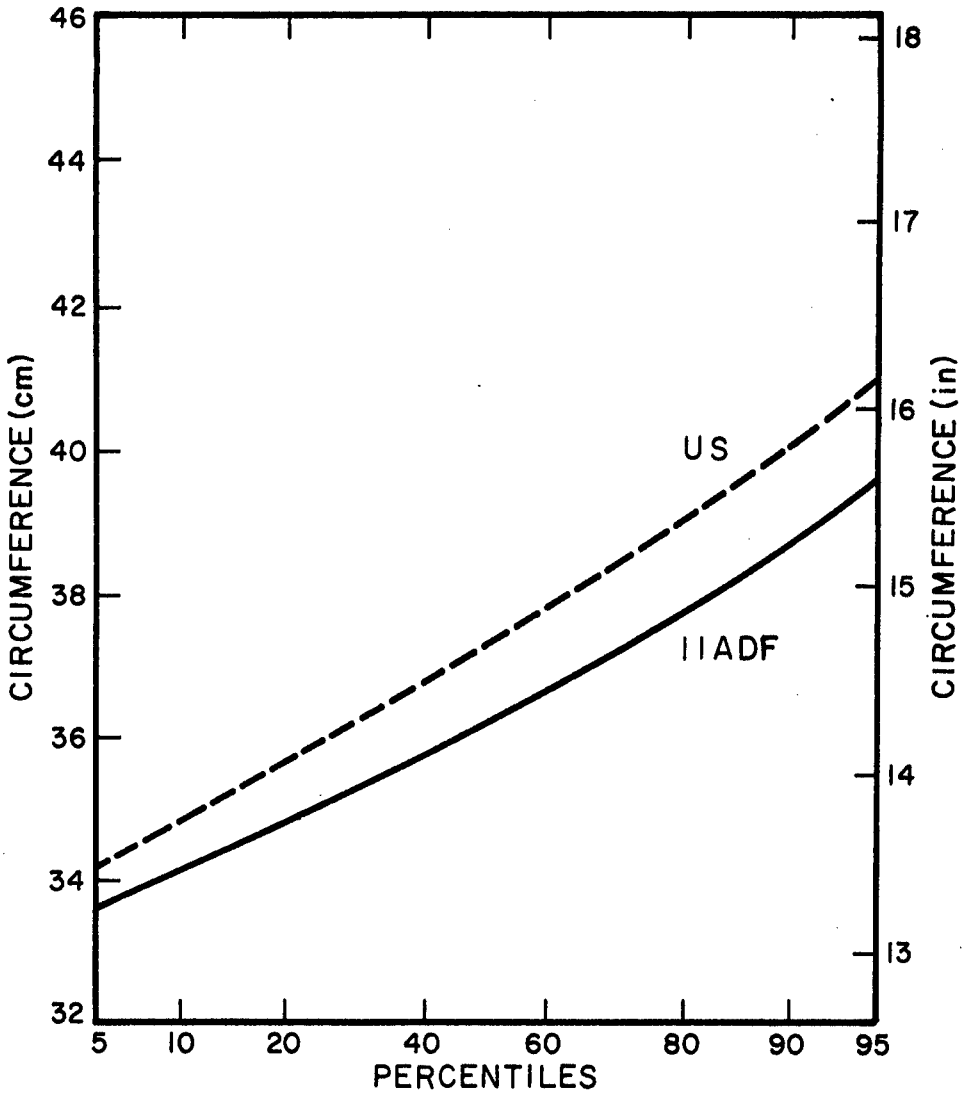



CHART VI COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR NECK CIRCUMFERENCE (5th TO 95th PERCENTILES)

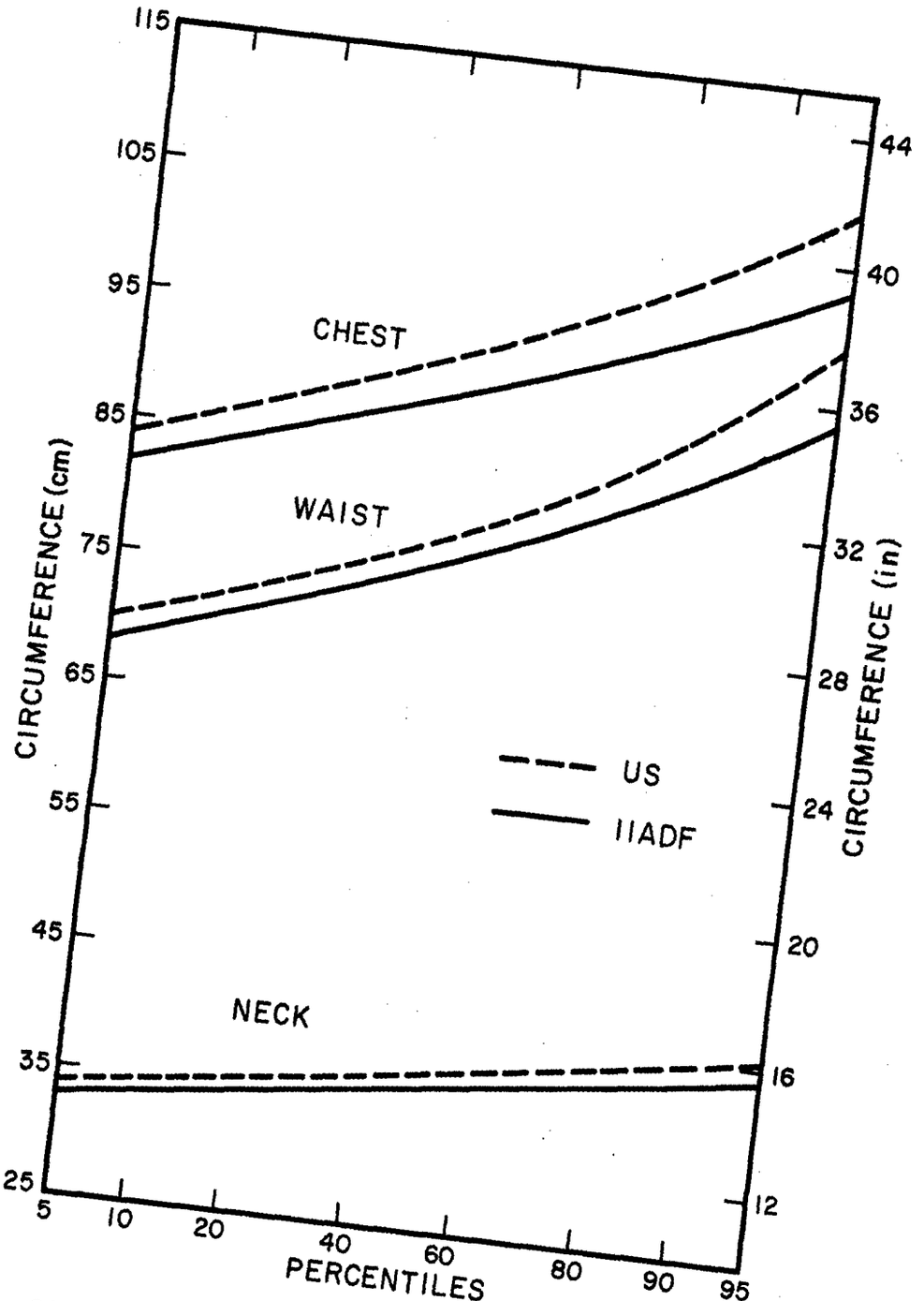



CHART VII COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR CHEST, WAIST, AND NECK CIRCUMFERENCES (5th TO 95th PERCENTILES)

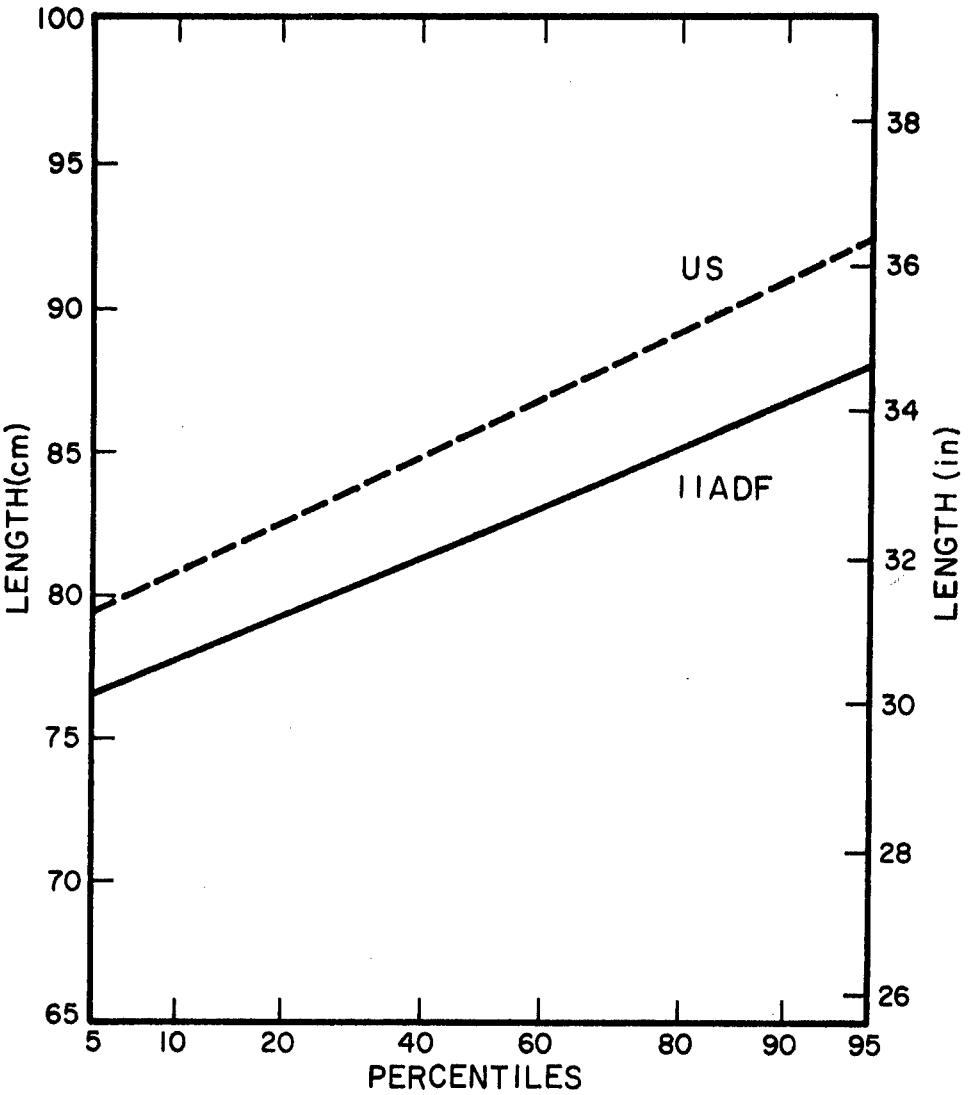



CHART VIII COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR SLEEVE LENGTH (5th TO 95th PERCENTILES)

## Implications with Respect to Patterns for Clothing

Since basic proportions of Iranian and U. S. troops are the same, in respect to the critical measurements used in clothing design and pattern making, other than for leg and sleeve length, it is apparent that the graded patterns used by the U. S. Army for its shirts and trousers could be used without alteration by the Iranian Army in its production of uniforms. The only adjustment that would need to be made would be in the tariff of sizes, with a greater proportion of smaller sizes; i.e., with a basic adjustment of sizes about one size smaller throughout.

There is one important qualification to this statement, however. It would be correct only if the same concept of fit applies. In other words, if the Iranian Chief of Staff visualizes his troops wearing their uniforms with fitting characteristics similar to those used by U. S. troops, then the same patterns could be used. If a different concept of fit is contemplated, then the patterns would need to be basically changed to achieve a different appearance.

### 1. Officers' Uniforms

The basic concept of fit of the U. S. Army officers' uniform is that it should be "semi-fitting", i.e., fitted over the shoulder, but fitted moderately loosely over the torso, not "boxy" and not snug fitting. The U. S. Army uniform is not worn with a belt. If a belt were to be worn, the patterns would need to be taken in slightly at the waist to fit more snugly at this point.

Except for the lower pockets, the uniform coat of the Iranian Army officers is closely similar to that of U. S. Army officers. Accordingly, if a standard pattern is desired, the U. S. patterns could be used with modification only at the waist to allow for use of a belt and to provide for different design in the lower patch pockets.

### 2. Shirts

With respect to shirts, again the U. S. patterns could be used. However, here it is important to point out that the U. S. Army fits our long sleeve shirts by neck and sleeve length measurements only; also our shirts are sized at the neck to permit wearing a necktie, i.e., in one-half inch intervals.

Since it has been observed that the Iranian Army enlisted men's uniform does not include a necktie, shirt sizing could be done on the basis of one-inch intervals and still have a good fit. The size might be stretched a bit further at some sacrifice of appearance.

Also, there is the matter of fullness in the shirt body. To accommodate men of varying waist girth dimensions, most civilian shirts are "bloused" in the body. So-called "tapered shirts" are also made, which fit more snugly over the torso, and are trim at the waist. For a slender figure this works out all-right, but men with larger waist girth would require extra sizes. In a climate as varied as that of Iran, we would consider bloused shirts such as are worn by U. S. troops, to be preferred. A closer fit could, of course, be selected if such a concept of fit is desired.

One answer could be for men to take their shirts to their local tailors and have them altered to fit snugly. As previously indicated, this is wasteful, an improper financial burden upon the soldiers, and may be destructive of uniformity of appearance.

### 3. Trousers

It is conventional in the U. S., both in the civilian trade and in the Army, to produce wool trousers with the bottoms unhemmed, and to fit them at the time of issue to the proper length. Since the trousers do not have cuffs, this is not a serious problem.

On cotton type trousers, it is considered more economical to make the trousers with finished bottoms, even though this requires more sizes.

If alteration facilities are available at point of issue, both trousers should probably be made available with unfinished bottoms and then fitted to proper length at the time of issue. U. S. Army trouser patterns would prove acceptable either with or without alteration in leg length at the time of issue. If narrower trousers are desired, then all of the patterns would need to be modified. This would involve a major pattern development, although it could be done by skillful pattern experts.

### 4. Summary

U. S. Army patterns for the above uniform items apparently will give a good fit to Iranian troops. The only change that would be needed would be to accommodate the difference in leg and sleeve lengths. If a different concept of fit or appearance is desired, then the basic body patterns would need to be remade. This would involve a project of major magnitude that would require the employment of highly skilled pattern makers.

## Recommended Tariffs

As previously pointed out, it is not possible to over-emphasize the importance of the concept of fit in a uniform. This shows up in several ways, but in no more important a way than in the number of sizes provided for issue to troops, and in insuring that men are issued the size that is proper for them in accordance with the approved concept of fit.

We believe that good appearance can only be attained by making the uniform in the right number of sizes, and getting a good fit when the items are issued. We are completely opposed to allowing the practice of permitting men to go to a commercial tailor and have his garments remade or refitted to suit himself.

Also, we consider that the soldier should either be given a generous allowance of clothing at his initial issue, or be allowed to purchase at cost, additional items so that he can keep them clean, and thereby maintain a neat appearance at all times.

We are accordingly recommending two alternate tariff schedules for shirts and trousers for consideration. The first is the one we would prefer, as it is based upon long experience both in civilian and military usage for a shirt with a stand-up collar and long sleeves. It is based upon a one-inch grade in neck sizes and a one-inch grade in sleeve sizes. It would be appropriate for the semi-dress or garrison shirt of the IIGF uniform. This tariff is as follows, using U. S. measurements in inches:

TABLE II

Shirt Tariff for Semi-Dress Shirts

(per 1000 items)

(Based upon one inch neck sizes and one inch sleeve sizes)

| | | Sleeve Length | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 29 | 30 | 31 | 32 | 33 | 34 | Total |
| Neck Size | 13½ | 13 | 10 | 16 | 15 | | | 54 |
| | 14½ | 37 | 41 | 70 | 108 | 66 | 22 | 344 |
| | 15½ | 25 | 30 | 76 | 154 | 137 | 52 | 474 |
| | 16½ | | | 16 | 41 | 48 | 23 | 128 |
| | Total | 75 | 81 | 178 | 318 | 251 | 97 | 1000 |

If a two-inch interval in sleeve length grading can be used, the tariff would be as follows:

TABLE III

Shirt Tariff for Semi-Dress Shirts
(per 1000 items)

(Based upon one inch neck sizes and two inch sleeve sizes)

| | | Sleeve Length | | | |
|---|---|---|---|---|---|
| | | 30 | 32 | 34 | Total |
| Neck Size | 13½ | 23 | 31 | | 54 |
| | 14½ | 78 | 178 | 88 | 344 |
| | 15½ | 55 | 230 | 189 | 474 |
| | 16½ | | 57 | 71 | 128 |
| | Total | 156 | 496 | 348 | 1000 |

For a short-sleeve shirt, with an open collar at the neck, such as is worn by U. S. troops in the summer, and which would be a very practical uniform for Iranian troops, the tariff would be as follows:

TABLE IV

Shirt Tariff for Short Sleeve Shirt with Open Neck
(per 1000 items)

| Size | |
|---|---|
| Extra Small (13 - 13½) | 54 |
| Small (14 - 14½) | 344 |
| Medium (15 - 15½) | 474 |
| Large (16 - 16½) | 128 |
| Total | 1000 |

For trousers issued with open bottoms, to be hemmed at the time of issue, the only grading required would be at the waist. When hemmed, this should be done on the basis of one-inch intervals in which case the following tariff should be used:

TABLE V

Trouser Tariff for Semi-Dress Trousers

(per 1000 items)

(Based upon one inch intervals at the waist measurement)

| | | Inseam (when hemmed) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | Total |
| Waist Size | 27 | 2 | 4 | 6 | 6 | 11 | 6 | 3 | 1 | 39 |
| | 28 | 5 | 11 | 11 | 16 | 21 | 15 | 6 | 2 | 87 |
| | 29 | 7 | 17 | 19 | 20 | 43 | 25 | 12 | 2 | 145 |
| | 30 | 10 | 17 | 19 | 24 | 44 | 31 | 13 | 3 | 161 |
| | 31 | 11 | 23 | 23 | 24 | 50 | 33 | 15 | 6 | 185 |
| | 32 | 10 | 17 | 18 | 22 | 37 | 28 | 10 | 3 | 145 |
| | 33 | 6 | 14 | 14 | 16 | 29 | 20 | 10 | 2 | 111 |
| | 34 | 4 | 8 | 10 | 10 | 19 | 10 | 5 | 2 | 68 |
| | 35 | 2 | 5 | 5 | 6 | 10 | 7 | 2 | 1 | 38 |
| | 36 | 1 | 2 | 4 | 4 | 5 | 4 | 1 | | 21 |
| Total | | 58 | 118 | 129 | 148 | 269 | 179 | 77 | 22 | 1000 |

If a two-inch interval at the waist is considered satisfactory, then the following tariff would apply:

TABLE VI

Trouser Tariff for Semi-Dress Trousers

(per 1000 items)

(Based upon two inch intervals at the waist measurement)

| | | Inseam (when hemmed) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | Total |
| Waist Size | 28 | 7 | 15 | 17 | 22 | 32 | 21 | 9 | 3 | 126 |
| | 30 | 17 | 34 | 38 | 44 | 87 | 56 | 25 | 5 | 306 |
| | 32 | 21 | 40 | 41 | 46 | 87 | 61 | 25 | 9 | 330 |
| | 34 | 10 | 22 | 24 | 26 | 48 | 30 | 15 | 4 | 179 |
| | 36 | 3 | 7 | 9 | 10 | 15 | 11 | 3 | 1 | 59 |
| Total | | 58 | 118 | 129 | 148 | 269 | 179 | 77 | 22 | 1000 |

If trousers are to be issued with hemmed bottoms, then we would recommend issue by two-inch intervals at the waist and two-inch intervals in leg length, simply to hold down the number of sizes, even at some sacrifice in uniformity of leg length and over-all appearance.

For this issue, the following tariff would be recommended:

TABLE VII

Trouser Tariff for Semi-Dress Trousers

(per 1000 items)

(With hemmed bottoms, and two-inch intervals at both the waist and trouser bottoms)

| | | Inseam | | | | |
|---|---|---|---|---|---|---|
| | | 27 | 29 | 31 | 33 | Total |
| Waist Size | 28 | 22 | 39 | 53 | 13 | 127 |
| | 30 | 51 | 83 | 143 | 30 | 307 |
| | 32 | 61 | 88 | 146 | 34 | 329 |
| | 34 | 33 | 49 | 78 | 19 | 179 |
| | 36 | 11 | 20 | 27 | | 58 |
| | Total | 178 | 279 | 447 | 96 | 1000 |

Turning now to field uniform items or fatigues, the question to be answered with respect to tariff is how good an appearance is desired and the logistics of supply. In the U. S. uniform system we have heretofore used a four-inch grade in fatigue and combat uniforms. Within the past few years, this has been changed to a two-inch interval system in waist and chest measurements, even though it has necessitated an increase in the logistic problem of keeping a larger number of sizes in the supply system.

It is not possible, on the basis of knowledge provided to the writer of this report, to know the concept of appearance which influences Iranian army thinking on this point. Our judgment, however, based upon general comments as to the desire to improve the appearance of the Iranian Armed Forces is that it would be better to go to a maximum of a two-inch grading system, and to make a determined effort to build morale and esprit de corps through enforcing a good military appearance at all times through wearing smart

appearing and properly fitted uniforms. This could best be done through adopting a two-inch grading system as the maximum on all items of outer clothing provided to troops.

A final word should be said with respect to computed tariffs. The best that can be done in preparing a computed tariff is to balance off the body sizes of the troops against the corresponding measurements of the finished garments, based upon properly designed and balanced patterns that have been properly graded. The underlying principle that governs all of this, as has been repeatedly pointed out, is that the patterns have been based upon an approved concept of fit.

Thus, when the wrong size garment is issued to a man, if his proper size is not available because the proper discipline is not exercised at the time of issue so that the man receives his proper size, this will throw off the tariff schedule and create an imbalance in stocks of sizes. If men are not fitted in accordance with the approved concept of fit, or if stocks are not managed correctly so that a full range of sizes is available at the time of issue so that the proper size can be provided, the tariff will also be thrown off.

It is essential, accordingly, for a standard tariff to be effective, that a full range of sizes is available at the time of issue, and that command control is exercised to see that men are fitted correctly at the time their clothing is issued. In the U. S. Army, this is a command responsibility of the company commander.

Over and beyond this, it must be recognized that master tariff schedules must be adjusted, based upon experience data.

The U. S. regulation pertaining to issue and fitting of clothing has been included in abbreviated form as Appendix I.

## The Short "Battle Dress" Jacket

In the discussion of the Iranian uniform up to this point, reference to the "Battle Dress" jacket has been omitted, since it presents a whole series of very difficult problems, and since at this time, there is no U. S. counterpart to this item. The U. S. Army had such an item up to about eighteen years ago, and the U. S. Air Force retained one for a few years after that, but it has been discarded today, even by the British Army and most of the armies of the Commonwealth.

This style of jacket which was developed by the British Army many years ago, served as the inspiration for the so-called "Eisenhower" jacket adopted by the U. S. Army during World War II. In its original concept, it was intended both as an item of garrison uniform and as a field item. Its abandonment by nearly all armies in recent years, including both the British and U. S. Forces, reflects the inability to make it serve satisfactorily for either use. In its place both armies have adopted a coat for the Class A uniform (for service or garrison wear) and separate functional clothing for field or combat wear.

The Battle Dress jacket presents an unusually difficult problem in fitting since it must be fitted in four dimensions:

1. Across the shoulders
2. In sleeve length (it has a shirt cuff which is difficult to alter)
3. In waist length (from neck to waist so it will fit over the trouser belt)
4. In waist girth (it has a waistband that cannot be let out)

Various expedients have been tried to solve these fitting problems. The British wore very high-rise trousers with suspenders and bloused the jacket both in front and back, so there would not be separation at the waist when they bent over.

The final U. S. attempt to make the jacket suitable was to eliminate the blousing at the front, but to blouse the jacket in the back. This was the design as adopted by the Air Force in 1949. It is probably the best compromise design that will give a satisfactory appearance.

There is the further problem of cleaning. In its usual design, the jacket is made from a wool fabric and has too much tailoring to be truly washable. It must accordingly be dry cleaned to avoid losing its shape and overall appearance. For the enlisted man this can be a serious cost factor.

One possible solution with respect to this item of the IIGF uniform would be to make universal the practice which is apparently followed by the Iranian Military Police and the Imperial Guards Brigade of wearing this jacket tucked into their trousers. This would solve

the problem of trying to fit the jacket in length and in waist girth since it could be provided with slits at the sides and the waistband could either be ignored or even eliminated. In effect, this would convert the item into what would amount to a shirt, except that it would have the military pockets and the collar of a tailored coat. This would still leave the problem of cleaning which in a wool item of this kind should be done by dry cleaning.

Without more information as to the goal of the IIGF in respect to the ultimate desired appearance of their military forces, it is not possible to make significant recommendations with respect to this item other than the following:

1. It should certainly be issued on a two-inch grade in chest girth and in at least two lengths.
2. The item should be fitted as well as possible at the time of issue.
3. Wearing it tucked in at the trousers would present a better appearance than allowing it to hang loose in varying degrees of fit and varying lengths over the hips.
4. The whole question of a semi-dress uniform for the IIGF should be re-examined, and if this garment is to be retained, then its construction, design and appearance concept should be reconsidered. For general duty wear, it probably should be replaced by a well-made and well-fitted shirt, possibly worn with a necktie under some conditions, which could be constructed so as to be readily washable while still retaining a good appearance. This would make possible the retention of this short "Battle Dress" Jacket, if so desired, as a true item of a semi-dress uniform, in which case it could be tailored and fitted to give it a smart military appearance.

## Conclusions

1. The anthropometric study has provided a basis for pattern development and for tariffs for the items of the IIGF uniform.

2. The close relationship between the Iranian and U. S. Forces in body dimensions indicates that the same patterns can be used with only limited alterations to the extent that the concept of fit and appearance is the same.

3. A larger number of sizes is needed to obtain good appearance and fit.

## Recommendations

1. A larger number of sizes should be provided in all items to reduce the need for alterations and to achieve good fit.

2. Fitting instructions should be provided for use at the point of issue, and care taken to insure proper fit and appearance at the time of issue.

3. The Battle Dress Jacket should be re-studied as to design and function to solve the problems associated with fitting it to give a good military appearance

## APPENDIX I

## PROPOSED REGULATION
## FOR THE FITTING OF MEN'S UNIFORMS
## OF THE IMPERIAL IRANIAN GROUND FORCES

### 1. Purpose and Scope

This manual is a guide for personnel engaged in the fitting of service or semi-dress uniforms for male personnel of the Imperial Iranian Ground Forces.

### 2. Approved Concept of Fit

The Army considers only one appearance as acceptable. This is called the approved concept of fit, and is the official manner in which the shirt, trousers, jacket, overcoat or other outer garment should conform to the body. The approved concept of fit of a uniform or separate garment is the fit and appearance when an individual is fitted with the correct size for his measurements. High morale and pride are created and sustained when the wearer is confident of being well dressed and is at ease in his clothing.

The approved concept of fit of the uniform of the Imperial Iranian Ground Forces is illustrated in the accompanying figures.

(At this point there should be photographs taken of a soldier wearing each uniform in the manner which represents the appearance which the Chief of Staff desires to achieve with each member of the Ground Forces.)

The following statement is representative of a statement that might be made as to the proper concept of fit:

Concept of Fit

(1) Shirt — The shirt fits easily over the chest and shoulders and permits free use of the arms without discomfort.

(2) Trousers — The trousers fit smoothly (but not tightly) around the hips, seat, and waist, and hang straight from the seat with no baggy effect. The fronts rest on the top of the shoe without a break. Breaks may occur with newly fitted trousers because of the allowance for shrinkage.

3. Responsibility

It is the duty of every commanding officer, regardless of grade, to insure personally that he himself is fitted in accordance with the approved concept of fit, that he presents the proper military appearance, and that each member of his command is properly fitted with a neat and proper uniform which will reflect the approved concept of fit and appearance.

4. Proper Fitting of Uniform

The basic objective in fitting uniforms is to provide each individual with garments selected from tariff sizes so that each garment will fit properly with a minimum of alterations. With a full range of sizes, and if the fitter understands his responsibilities, he will be able to achieve a proper fit and appearance with most individuals with tariff-size garments without the need for alterations. Tariff-size garments are those sizes of clothing which are regularly procured and are available in the supply system. A complete range of tariff sizes of all items must be kept in stock at all times at points where issue of clothing or uniforms is made.

5. Fitting Procedures

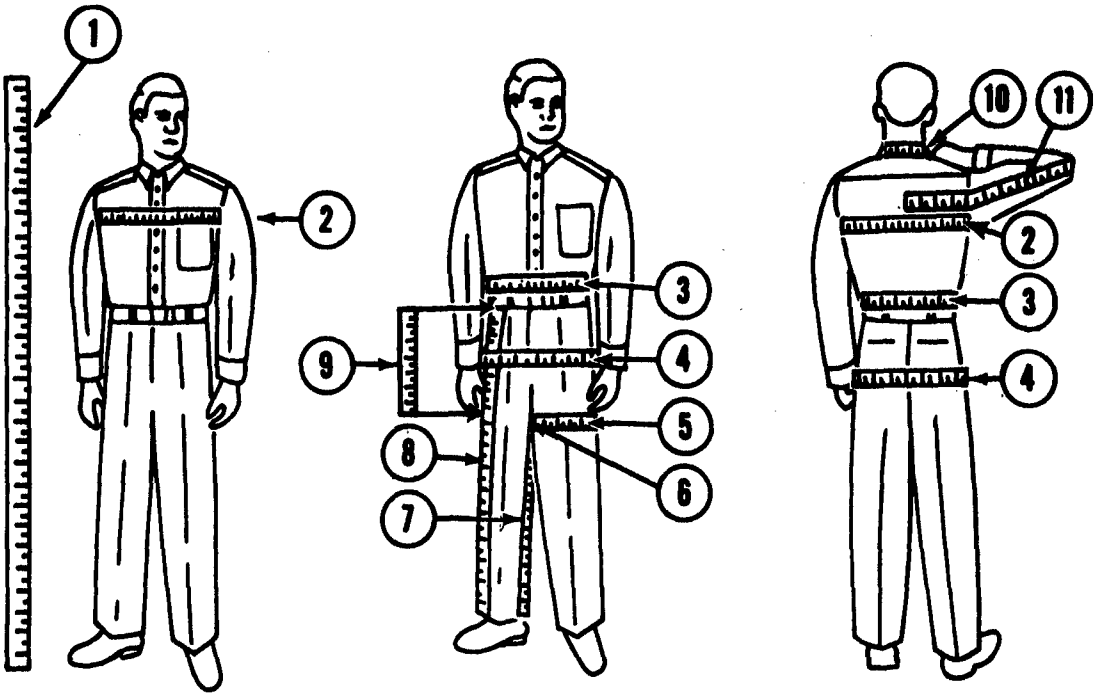
a. Physical Measurements

Key points of fitting measurements are shown in Figure 1. They should be taken over the appropriate sub-garment, i.e., any item of clothing required to be worn under the garment being fitted.

b. Initial Try-on

Using the physical measurements which are applicable, make an initial selection of a sized garment which carries the size measurements corresponding to those of the individual. Thus, for a shirt, try on that size which corresponds to his neck and sleeve measurements; for trousers, that size that corresponds to his waist measurement, and if the trouser legs are hemmed, that which corresponds to his inseam measurement. For the short "Battle Dress" jacket, see that it fits properly at the shoulders and across the chest. (For other measurements, see comments elsewhere in this report on this garment.)

If the item does not fit properly, try on the next larger or smaller size, and only then, if a good fit is not obtained, have the garment marked for alteration.




**1 HEIGHT**

From floor to natural height with subject standing in an erect manner. This measurement must be exact, as it regulates the length of the coat and the depth of the waist.

**2 INSIDE CHEST**

Place tape well up under the arms and over the shoulder blades on a horizontal line, taking the floor as a level. This measurement is taken snug. Take measurement from center of the back instead of the front, with the subject standing in a natural position and not with the chest fully expanded.

**3 WAIST**

Measure around waist on the shirt just above the trousers at a point directly over the hipbones; snug, but not tight.

**4 SEAT**

Measure around the largest part of the hips or seat.

**5 WIDTH OF LEG**

Measure around the thigh, just below the crotch level.

**6 CROTCH**

The point of the human body where the legs fork from the pelvis. This is not a measurement, but is a point from which measurements are taken.

**7 INSEAM**

Place the tape firm and well up against the crotch at (6), and measure down to the floor along the leg of the inside seam and subtract 2 1/2 inches.

**8 OUTSEAM**

Place the tape on the subject just above the hipbone, on the lower edge of the waistband seam, and measure to the bottom of the trousers. The measurement is taken along the length of the outside seam.

**9 RISE**

This measurement is the difference between the inseam and the outseam measurements.

**10 NECK**

Measure the circumference of the neck at the collar line.

**11 SLEEVE**

Raise arm of the subject and bend the arm at right angle, bringing forward the forearm parallel to the floor, with palms down; measure from center of back to sleeve seam, continuing around the elbow to the wrist bone. This measurement gives the full sleeve length.

*Figure 1. Key points of fitting measurements.*

## 6. Fitting Dress Shirts

Long sleeve shirts are provided in one-inch neck size increments (or two-inch, depending upon final action to be taken with respect to the tariff of sizes). Sleeves are in one-inch (or two-inch) lengths.

a. Neck — Measure the neck for collar size by placing the tape evenly, but not snugly, around the middle of the neck.

b. Arm — To obtain the full sleeve length, direct the person being fitted to raise his arm parallel to the floor, bend it at the elbow to form a right angle, and bring the fore-arm forward with the palm down. With the arm in this position, measure from the center of the back (parallel with the elbow), along the arm, continuing around the elbow, to the lower part of the wrist bone (Fig. 1).

Try-On — Try-on size for dress shirts is determined by the neck and sleeve measurements. The sub-garment required is the cotton undershirt. Check the following points while the individual is wearing the try-on shirt:

a. Make sure the shirt is fully buttoned, including the sleeves.
b. Check to see that the collar fits snugly enough to give a neat appearance but not so snugly as to be uncomfortable.
c. Check to see that there is ample room around the chest and shoulders to permit free use of the arms without discomfort.
d. Make sure the sleeves fall to the lower part of the wrist bones.

NOTE: To allow for anticipated shrinkage from repeated laundering shirts are provided with a slight size overage at the neck and sleeves. These overages are approximately 3/8 inch in collar measurement and 1/2 inch in sleeve measurement. Both the fitter and the wearer must give due consideration to these overages.

### Short-Sleeve Shirts

(1) Sizing System — Sizes of short-sleeve shirts are as follows: extra small, small, medium, large, and extra large.

(2) Try-On — Try-on size for short-sleeve shirts is determined by the neck size only. The sub-garment required is the cotton undershirt. Check the same applicable points as those for the long-sleeve shirts.

Size Prediction Table for Short-Sleeve Shirts

| Neck Size (inches) | corresponds to | Adjective Size |
|---|---|---|
| 13-13½ | | Extra small |
| 14-14½ | | Small |
| 15-15½ | | Medium |
| 16-16½ | | Large |
| 17-17½ | | Extra large |

7. Fitting Trousers

Trousers are designed to fit smoothly, but not tightly, around the hips, seat and waist with a slight fullness for comfort. The measurement between the waist and the crotch is called "the rise" of the trousers. The required amount of "rise" is automatically graded into the trousers in the patterns for different lengths of trousers. This provides for proper fitting in the seat, around the hips, in the crotch, and at the waist.

Trouser waist measurements are sized in one-inch intervals (or two-inch; see previous note). (Statement with regard to lengths will depend upon whether the trousers are furnished with unfinished bottoms, or with hemmed bottoms.)

Fitting the seat properly is the most important fitting feature. There should be room enough around the hips to prevent spreading of the side pockets and to allow for comfort and stride on normal movements, such as sitting, climbing stairs, and marching. Whenever there is a question as to which of two sizes is more suitable, select the trousers which fit the seat better, even though a waist alteration may be required.

Trousers should fit easily around the waist without bulging, with the bottom of the waistband resting at the top of the hipbone. The waist should have approximately one-half inch of ease.

Check the trousers for the approved length. They must hang straight from the seat so that the fronts rest on the tops of the shoes without a break. Before marking trouser bottoms for alteration, if required, be sure the individual is wearing his shoes.

8. Fitting of Other Garments, such as Overcoats

Corresponding fitting instructions should be developed for proper fitting of other outer garments.

NOTE: This proposed regulation on the fitting of men's uniforms for the Imperial Iranian Ground Forces is based upon the corresponding U.S. Army Technical Manual, TM 10-227, "Fitting of Men's Uniforms", dated October 1967. For further suggestions on the preparation of a regulation on this subject for the IIGF, it is suggested that this Technical Manual should be reviewed.

# COMBAT BOOT STUDY PROJECT

# IMPERIAL IRANIAN ARMED FORCES

## TECHNICAL SUMMARY

by

Stephen J. Kennedy, Ph.D.

Robert M. White

May 1971

# COMBAT BOOT STUDY PROJECT

## TECHNICAL SUMMARY

## LIST OF TABLES



## LIST OF CHARTS

# COMBAT BOOT STUDY PROJECT

## TECHNICAL SUMMARY

### Introduction

What has been said elsewhere in regard to the application of anthropometric measurements to clothing is applicable also in general to footwear, with the substitution of "footwear Lasts" for patterns. The last is the three-dimensional expression of the foot dimensions, modified to provide the proper internal volume and dimensions to accommodate the walking foot.

### Application of Anthropometry to Last Development

The last used in the production of the U.S. Army boot prior to and during World War II had serious shortcomings that contributed to foot disorders, particularly in cold climates. Accordingly, The Surgeon General conducted a careful anthropometric study of foot dimensions in 1945-46, to obtain data on which a new last could be developed on a scientific basis. This study was published by the Armored Medical Research Laboratory at Fort Knox, Kentucky under the title, "Foot Dimensions of Soldiers."

The last for combat footwear which was developed on the basis of this study and which is now being used by the U. S. Army is the U.S. Mil-5 Last. It has been in use for the past eight years and its good fitting characteristics have been demonstrated.

Because of the very considerable cost that would be involved in developing a new last for the Imperial Iranian Ground Forces, it has been considered desirable to compare the measurements obtained in the anthropometric study of the IIADF with the measurements obtained in the U. S. Army anthropometric survey which was used in producing the U.S. Mil-5 Last. A comparison should also be made with the last presently being used in the production of boots for the IIGF.

The most striking feature of the present last being used in the production of boots for the Imperial Iranian Ground Forces is its pronounced in-flare. In fact,

it shows a more pronounced in-flare than any other last for men's shoes that we have seen used. By "flare" is meant the direction in which the forward part of the foot points in relation to the axis of the heel.

The study, "Foot Dimensions of Soldiers" just referred to, included a study of this aspect of the foot. Men stood on a glass plate, and the shape of the bottom of their feet was photographed from below. This aspect of the foot is shown in Chart I which shows the range of the flare of men's feet as shown in the U.S. study for 95% of the population. As will be noted, almost no men have a definite in-flare, most having an out-flare or neither an in-flare or out-flare.

While the Iranian anthropometric study did not include a study of foot flare, it can be accepted that the feet of Iranian soldiers do not differ significantly in this respect from those of U. S. troops. The data in the U. S. study are quite convincing, as they do not even show any racial difference between white and black soldiers included in the study in respect to the flare of their feet.

The first conclusion to be drawn from this study, accordingly, is that a change in the footwear last from the present last used for Iranian Army boots, with its pronounced in-flare to a straight-draft last, such as the U. S. Mil-5 Last would unquestionably be beneficial in obtaining a better-fitting marching or combat boot for the Iranian Armed Forces.

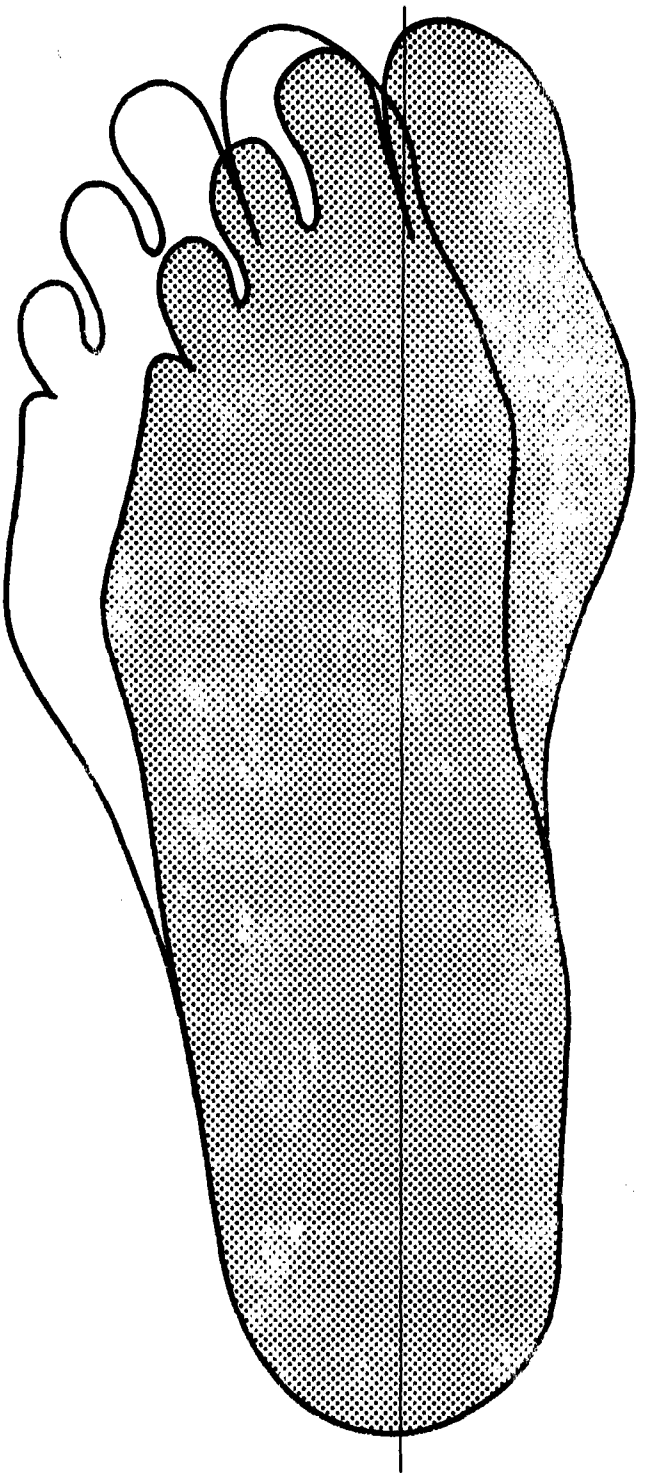


CHART I RANGE OF FOOT FLARE FOR 95% OF U.S. ARMY POPULATION

## Comparison of IIADF Anthropometric Data with Similar Measurements for the U.S. Armed Forces

In a direct comparison between the anthropometric measurements of the feet of the Iranian soldiers and American soldiers, certain important differences have emerged, which have required careful study. Unlike the situation which has been brought out in respect to the body dimensions which govern body clothing, where a close correlation of body types has been demonstrated, there are important differences in the feet.

TABLE I

Comparison of Foot Dimensions

of the Average American and Iranian Soldier (50th Percentile)

| | U.S. Army | | IIADF | | Difference | |
|---|---|---|---|---|---|---|
| | Inches | Centimers | Inches | Centimeters | In. | Cm. |
| Foot Length | 10.53 | 26.74 | 10.23 | 25.98 | -0.30 | -0.76 |
| Foot Breadth | 3.87 | 9.82 | 4.05 | 10.30 | +0.18 | +0.48 |
| Ball of Foot Circumference | 9.87 | 25.07 | 10.15 | 25.79 | +0.28 | +0.72 |
| Instep Circumference | 10.43 | 26.50 | 10.58 | 26.87 | +0.15 | +0.37 |
| Heel-Ankle Circumference | 13.42 | 34.08 | 13.25 | 33.67 | -0.17 | -0.41 |
| Heel Breadth | 2.69 | 6.83 | 2.68 | 6.80 | -0.01 | -0.03 |

In this Table it will be noted that the average U. S. soldier has a foot length which is 0.30 inches (0.76 cm.) longer than that of the average Iranian soldier. This is slightly less than one U. S. shoe size (0.33 inch) on the U. S. arithmetic grading system. In other words, the average boot size for the Iranian soldier would be about a U. S. size shorter than for the American soldier.

However, as shown in the foot breadth and ball foot circumference measurements, the Iranian soldier has a definitely wider foot. In foot breadth this amounts to 0.18 inches (0.48 cm.) or the equivalent of two widths in U. S. sizes; and in ball girth circumference, 0.28 inches (0.72 cm) or the equivalent of one U. S. width.

One other important measurement, instep circumference, shows only a relatively slight difference: 0.17 inches (0.42 cm.) which is not considered to be large enough to present any serious problem from the standpoint of last design, since it can be taken care of in the sizing of the patterns for the uppers.

Surprisingly, and contrary to some expectations, there is no significant difference in heel breadth.

There is one other measurement in the anthropometric data which could have significance, and that is the instep length, i.e., the distance from the rear of the heel to the center of the ball of the foot. With respect to this measurement, it is not possible to make a direct comparison between the measurements from the U. S. study and the Iranian Anthropometric Survey, since, as pointed out in Volume I of the Technical Report page 13, paragraph E.2.c, the measurements of this body dimension, as actually taken, deviated slightly from the instructions, so that the measurements came out smaller than they would have been had they been taken exactly as had been done in the U. S. survey and as called for in the instructions.

After making a statistical adjustment based upon limited data, however, it appears that the Iranian instep length appears to be only slightly shorter proportionately than on U. S. feet. In the measurement of American soldiers, instep length is 73.4% of foot length, whereas with Iranian feet it appears to be around 71%. This is not considered to be sufficient to require an adjustment in the last for instep length.

The differences in breadth of the foot are particularly important, however, as they definitely will have a bearing upon last sizing and the tariff. A wide-spreading foot in the forepart is not uncommon among people who have not worn western style footwear during their growing years. It does not indicate any abnormality, in fact it usually reflects strong development of the foot muscles and tendons and overall sturdiness in the foot musculature. The important point, however, is that provision of shoes built upon a proper last will be most important if soldiers with these foot characteristics are to be properly fitted and not to be subject to the foot disorders that are especially prevalent in military forces equipped with ill-fitting shoes. Foot disorders due to misfitting footwear may not show up at once, since the foot is relatively insensitive and can take a lot of abuse. Ultimately, however, it will register the results of improper fitting in the form of painful callouses, blisters, corns, ingrown nails, distorted toes, aching feet, and sometimes what are referred to as fallen arches.

What has been said so far applies to the <u>average sized man</u> who is identified in the anthropometric study as the fiftieth percentile man. As pointed out in the anthropometric study, percentile values are obtained by arranging size data in order from the smallest up to the largest value, as shown in Chart II which shows the distribution of Iranian soldiers according to stature.

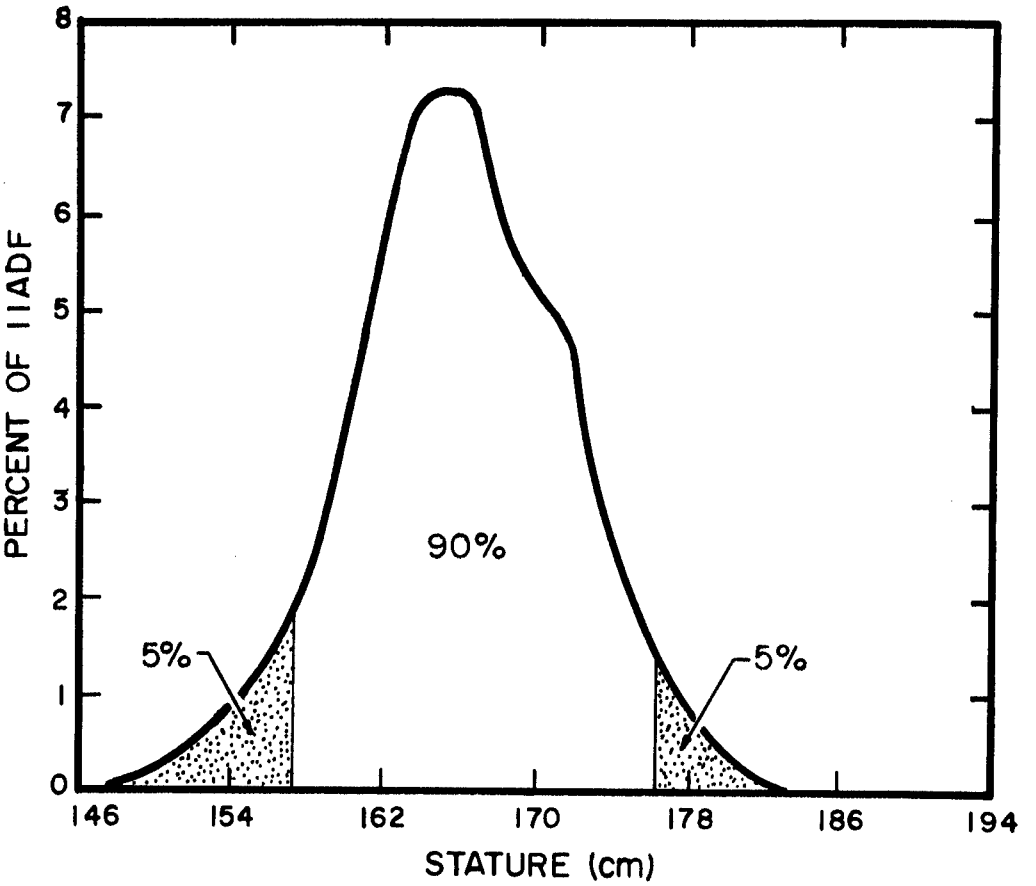



CHART II DISTRIBUTION OF STATURE
OF IIADF PERSONNEL

For practical purposes in designing, we disregard the smallest five percent of the population, i.e., below the fifth percentile, and the largest five percent, i.e., above the ninety-fifth percentile, since there are so few of them and since they usually require special measurement clothing or footwear anyway. Historically, there have been men with such large feet that they have been refused enlistment in the U. S. Army simply because there was no practical way to keep them supplied with the very large shoes they required. This is mentioned only to point out that unless very close fitting is attempted, as we do in the U. S. Army with over fifty-six regular sizes of boots supplied, in addition to the special supplementary sizes, the men at the two extremes of sizes can be overlooked in developing a regular tariff.

Looking now at the distribution of the entire military population in relation to these differences between Iranian and American soldiers' feet, it will be apparent in Charts III through VIII that there are fairly consistent differences throughout the entire range of sizes.

Thus in the matter of foot length, as shown in Chart III, at the fifth percentile the difference is 0.7 cm, and at the 95th percentile it is only one centimeter. Thus in foot length, the differential runs fairly consistently throughout the entire range.

Even in foot breadth, Chart IV, there is good consistency, although in the larger sizes the foot breadth is slightly greater; increasing from 0.3 cm. at the fifth percentile to 0.45 cm. at the 95th percentile. However, we do not consider this difference critical, as can be easily demonstrated in a fitting test of boots.

The same might be said for ball foot circumference. Chart V shows a decrease in the difference between the two sets of men in the larger sizes, which basically indicates that the Iranian foot is thinner and wider than the American.

The charts for Instep Circumference and Heel-Ankle Circumference (Charts VI and VII) confirm the very close relationship in shape of the feet of the two groups of men in all respects other than breadth in the forepart.

Contrary to some expectations, there is remarkable consistency in the sizes of heel breadth, except that in the larger sizes, the heels of U.S. soldiers grow somewhat larger than those of Iranian soldiers (Chart VIII).

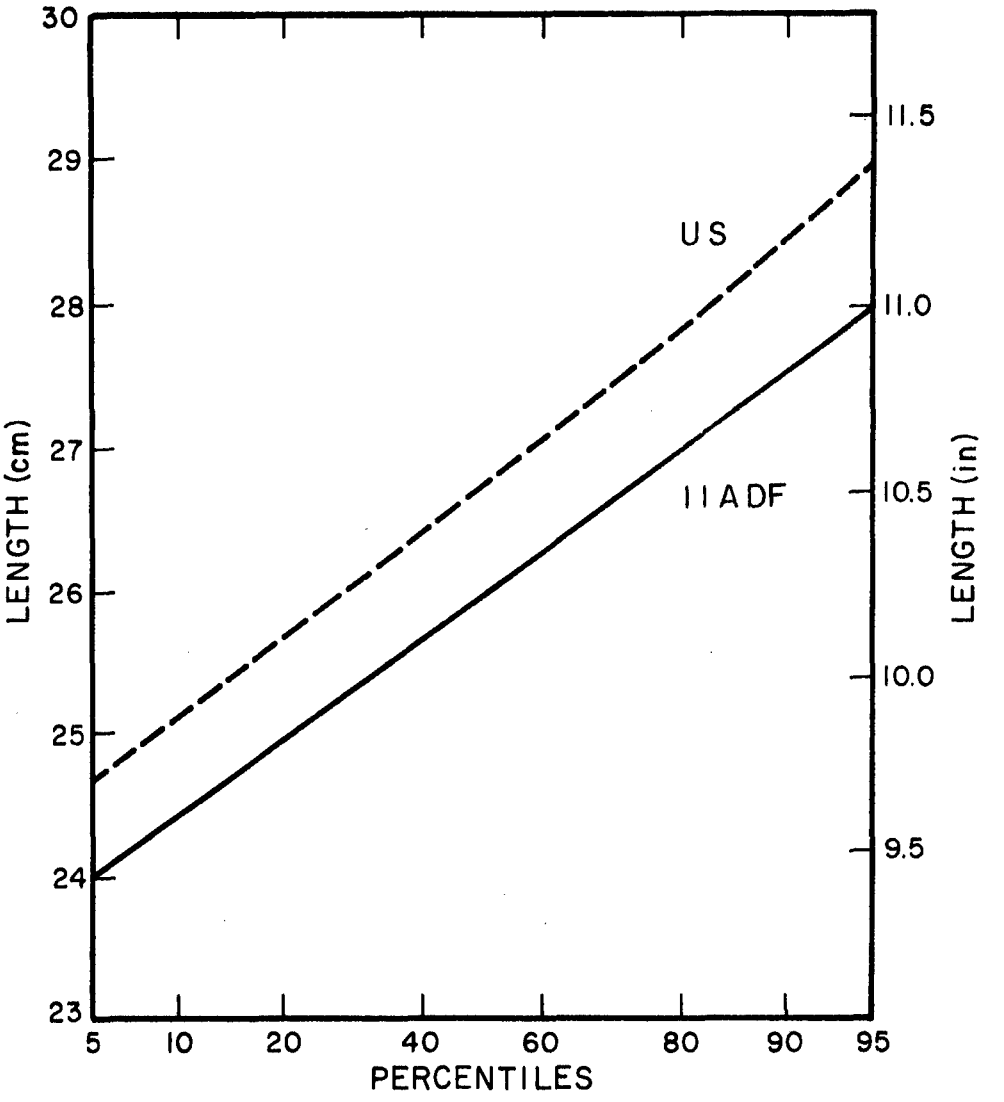



CHART III COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR FOOT LENGTH (5th TO 95th PERCENTILES)

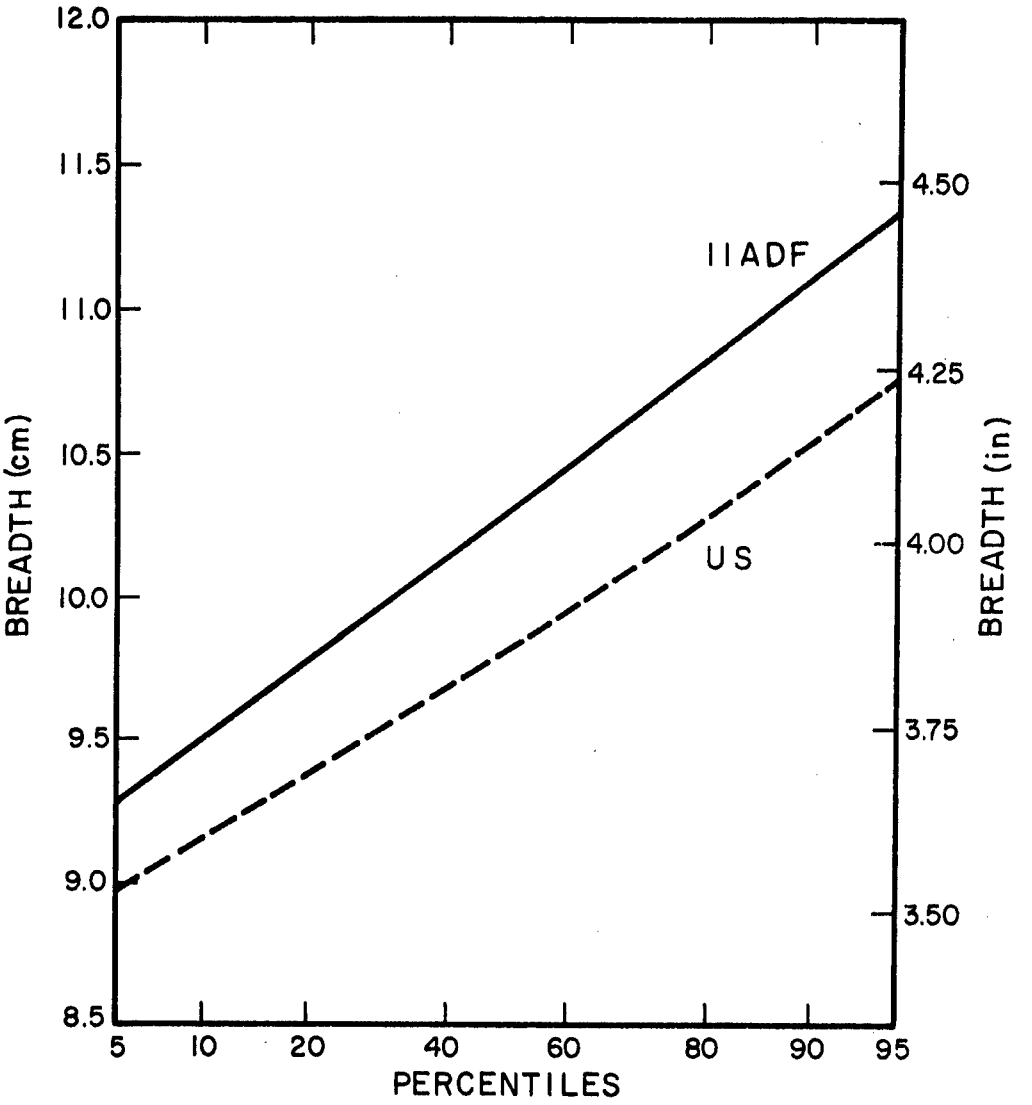



CHART IV COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR FOOT BREADTH (5th TO 95th PERCENTILES)

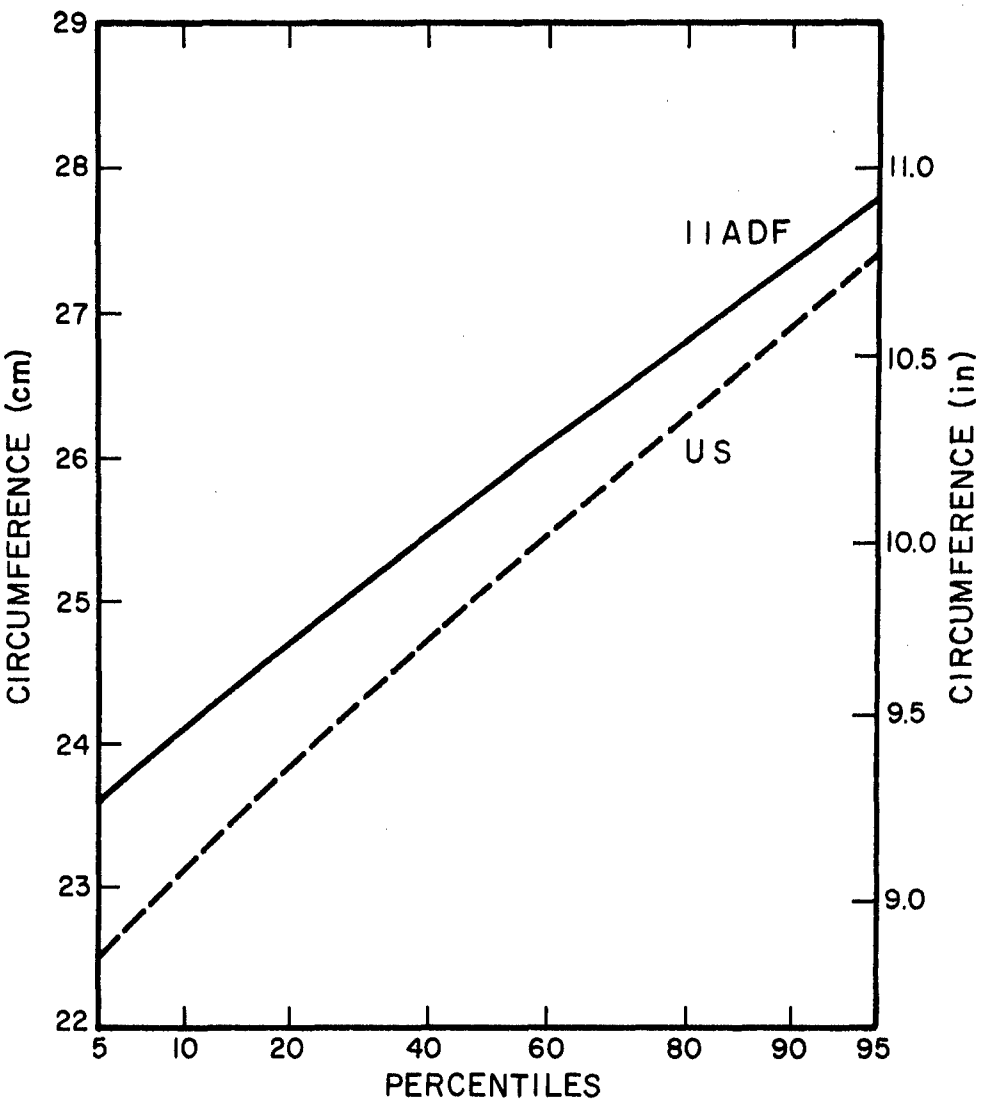



CHART V COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR BALL OF FOOT CIRCUMFERENCE (5th TO 95th PERCENTILES)

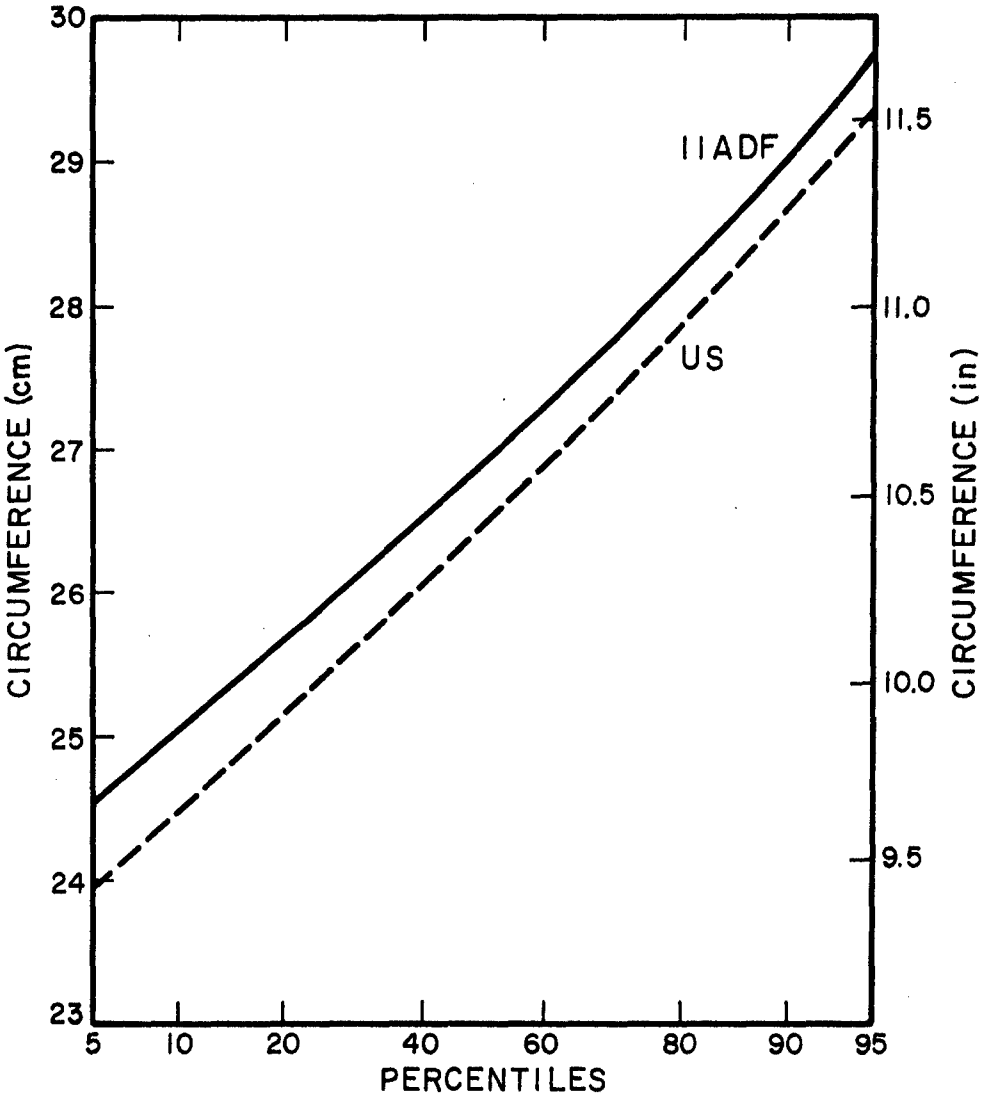



CHART VI COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR INSTEP CIRCUMFERENCE (5th TO 95th PERCENTILES)

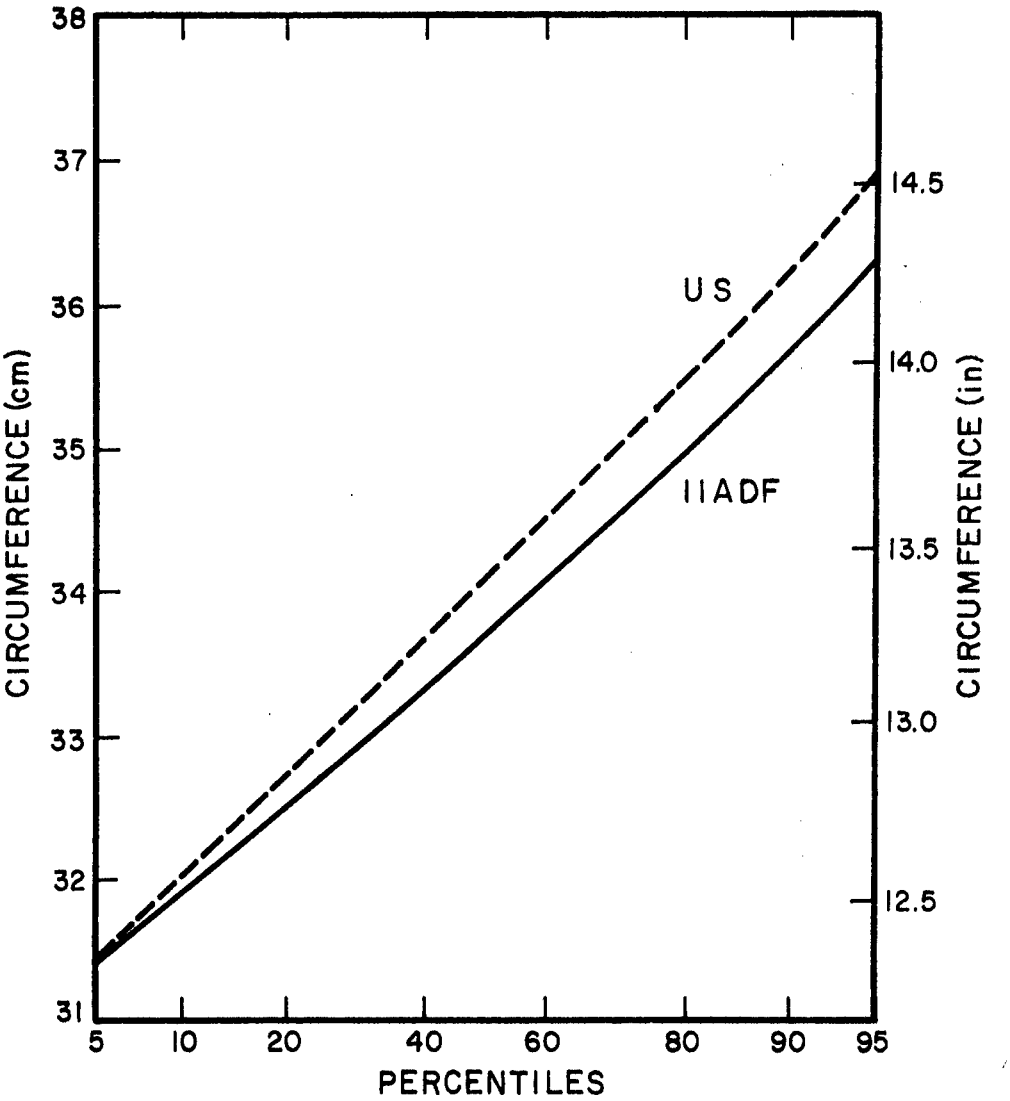



CHART VII COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR HEEL-ANKLE CIRCUMFERENCE (5th TO 95th PERCENTILES)

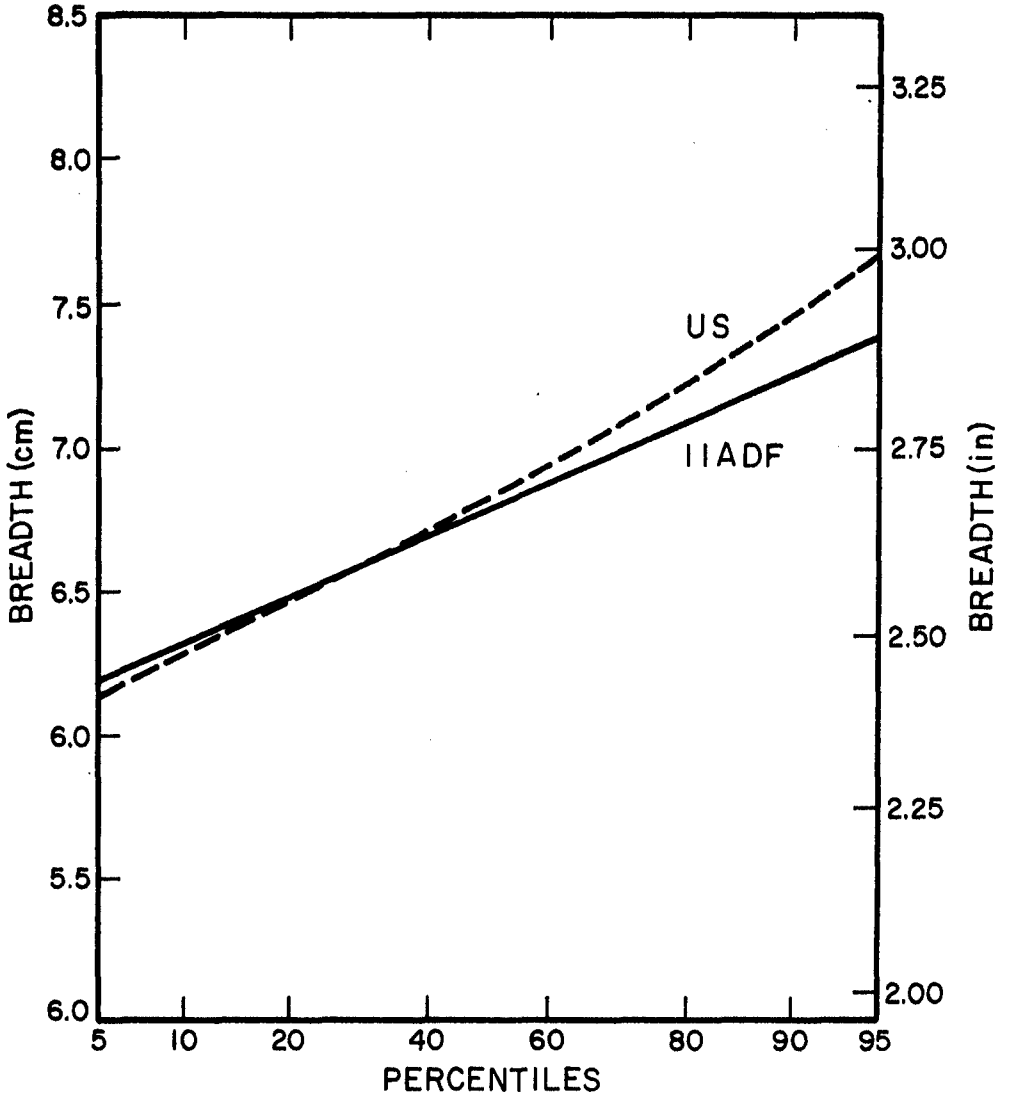



CHART VIII COMPARISON OF U.S. AND IIADF PERCENTILE VALUES FOR HEEL BREADTH (5th TO 95th PERCENTILES)

## Implications with Respect to Footwear Lasts for IIGF Military Boots

It is clear from the foregoing analysis that there are close relationships between the foot shapes and foot measurements of the Iranian and the American Armed Forces, despite the two important differences of foot length and foot breadth.

Since these two differences involve only normal adjustments of tariff sizes rather than basic differences in shapes of the lasts, it is clear that the Imperial Iranian Ground Forces could be fitted very well with the U. S. MIL-5 Last with only adjustments in the tariff of sizes: specifically, with shorter sizes and wider widths.

There certainly is no need to go to the expense and effort of attempting to develop a special last for Iranian troops based upon the anthropometric data. What clearly should be done is to conduct a fitting test of boots made over the U. S. MIL-5 Last. Should any minor modification of the last appear to be desirable upon conclusion of this test, this could easily be done by normal methods of last modification. Actually, since fitting of the IIGF has been accomplished in the past with only a limited range of sizes, it is most unlikely that the test will reveal any last fitting problems.

## Development of a Tariff of Sizes

In attempting to make recommendations as to the proper number and spacing of sizes of footwear for the IIGF, we are confronted with a problem which involves many factors on which we lack adequate information. There are factors of national custom as to how footwear is worn, factors relating to the type of complaints with footwear as it has been provided in the past, and particularly information as to the degree and kind of logistic support which can be provided in such a critical area as footwear.

In the U. S. Army we regard footwear as the most important item furnished in the soldier's clothing system, and proper fitting is of critical importance. For this reason, we feel that enough sizes should be provided to be assured that each man will get a good fitting pair of shoes. In fact, it is normal practice for shoe fitting to be checked by medical men to assure proper fit and foot health.

Whereas with clothing no particular health problem will be created if the clothing does not fit correctly — except in the extreme cold — with footwear the opposite is true. Men unable to march are casualties and may require medical treatment. Experience of all armies is that not only do men fight on their feet, but that their footgear is the most critical element in their clothing/equipment system.

This point has been stressed in this discussion since we shall propose a wholly new tariff of sizes, and more sizes than the IIGF has heretofore been supplied with. Also, we are recommending the adoption of the U. S. MIL-5 Last in an arithmetic grading system, which is conventional in your country, rather than the geometric grading system which is used in the U.S. Army boot lasts, as a matter of simplifying the production and fitting problems. Also the grade between sizes, which we are proposing, will be different from what you have used in the past in order to cover the entire military population with as good fitting lasts as possible.

An understanding of the way in which anthropometric data can be translated into size and tariff data can best be illustrated by comparison of the bi-variate distribution which appears on page IV-157 of the Iranian Anthropometric Survey (Chart IX) with a corresponding bi-variate distribution for U. S. troops (Chart X).

Both of these bi-variate distributions have been converted into percentage figures of the representative samples of men so that a direct comparison of the array and the trend in sizing can be seen. The similarity will be immediately evident both from a comparison of the shape of the bi-variate distribution and the actual figures. For purposes of simplifying the determination of a tariff, the figures shown in the Table for Iranian soldiers referred to above have been consolidated into groupings of 10 millimeters for both ball of foot circumference and foot length (it will be noted that U.S. figures are shown in inches and the Iranian in centimeters).

## CHART IX

BI-VARIATE DISTRIBUTION OF FOOT LENGTH AND BALL OF FOOT CIRCUMFERENCE FOR IRANIAN SOLDIERS

| Ball of Foot Circum. (Cm.) | Foot Length (Cm.) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 21.9 | 22.9 | 23.9 | 24.9 | 25.9 | 26.9 | 27.9 | 28.9 | 29.9 | 30.9 | 31.9 | Totals |
| 30.8 | | | | | | 0.0 | | | | | 0.0 | 0.0 |
| 29.8 | | | | | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | | 0.2 |
| 28.8 | | | | 0.0 | 0.1 | 0.6 | 0.6 | 0.3 | 0.1 | | | 1.7 |
| 27.8 | | | 0.1 | 0.2 | 1.4 | 2.6 | 2.3 | 0.7 | 0.2 | 0.0 | | 7.5 |
| 26.8 | | 0.0 | 0.1 | 1.6 | 5.4 | 7.4 | 3.5 | 1.0 | 0.1 | 0.0 | | 19.1 |
| 25.8 | | 0.0 | 0.9 | 4.6 | 11.7 | 9.1 | 3.2 | 0.4 | 0.1 | | | 30.0 |
| 24.8 | | 0.2 | 2.3 | 7.7 | 10.2 | 5.3 | 0.8 | 0.1 | 0.0 | | | 26.7 |
| 23.8 | 0.0 | 0.3 | 2.2 | 4.3 | 3.3 | 1.1 | 0.2 | 0.0 | | | | 11.5 |
| 22.8 | 0.0 | 0.3 | 0.8 | 1.0 | 0.7 | 0.1 | 0.0 | | | | | 2.9 |
| 21.8 | | 0.1 | 0.2 | 0.1 | 0.0 | 0.0 | | | | | | 0.4 |
| 20.8 | | 0.0 | 0.0 | 0.0 | | | | | | | | 0.0 |
| Totals | 0.0 | 0.9 | 6.5 | 19.6 | 32.9 | 26.3 | 10.7 | 2.6 | 0.5 | 0.0 | 0.0 | 100.0 |

## CHART X

### BI-VARIATE DISTRIBUTION OF FOOT LENGTH AND BALL OF FOOT CIRCUMFERENCE FOR U.S. SOLDIERS

Foot Length (Inches)

| Ball of Foot Circum. (inches) | 8.37 | 8.62 | 8.87 | 9.12 | 9.37 | 9.62 | 9.87 | 10.12 | 10.37 | 10.62 | 10.87 | 11.12 | 11.37 | 11.62 | 11.87 | 12.12 | 12.37 | 12.62 | Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12.37 | | | | | | | | | | | | | | 0.0 | | | | | 0.0 |
| 12.12 | | | | | | | | | | | | | | | | | | | |
| 11.87 | | | | | | | | | | | | 0.0 | 0.0 | | | 0.0 | 0.0 | | 0.1 |
| 11.62 | | | | | | | | | | 0.0 | 0.0 | 0.0 | | 0.0 | 0.0 | 0.0 | | | 0.1 |
| 11.37 | | | | | | | | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.5 |
| 11.12 | | | | | | | | 0.0 | 0.1 | 0.2 | 0.2 | 0.3 | 0.3 | 0.1 | 0.1 | 0.1 | 0.0 | | 1.4 |
| 10.87 | | | | | | | 0.0 | 0.1 | 0.3 | 0.4 | 0.8 | 0.8 | 0.5 | 0.3 | 0.1 | 0.1 | 0.0 | 0.0 | 3.4 |
| 10.62 | | | | | 0.0 | 0.0 | 0.1 | 0.3 | 0.9 | 1.4 | 1.4 | 1.4 | 0.9 | 0.4 | 0.2 | 0.1 | 0.0 | | 7.2 |
| 10.37 | | | | 0.0 | 0.0 | 0.1 | 0.3 | 0.6 | 1.9 | 2.6 | 2.6 | 1.9 | 1.0 | 0.4 | 0.2 | | 0.0 | | 11.6 |
| 10.12 | | | | | 0.1 | 0.2 | 0.8 | 1.7 | 3.1 | 3.6 | 3.3 | 1.7 | 1.0 | 0.3 | 0.1 | 0.0 | | | 16.0 |
| 9.87 | | | 0.0 | 0.0 | 0.2 | 0.5 | 1.4 | 2.9 | 4.1 | 4.3 | 4.3 | 2.5 | 1.5 | 0.8 | 0.2 | 0.0 | 0.0 | | 18.4 |
| 9.62 | | | | 0.1 | 0.2 | 0.5 | 1.7 | 2.9 | 4.0 | 3.2 | 1.9 | 0.9 | 0.4 | 0.1 | 0.1 | 0.0 | | | 16.0 |
| 9.37 | | | | 0.0 | 0.2 | 0.9 | 1.7 | 2.2 | 2.3 | 1.7 | 1.0 | 0.4 | 0.1 | 0.1 | 0.0 | | | | 10.8 |
| 9.12 | | | | 0.1 | 0.3 | 0.7 | 1.3 | 1.4 | 1.3 | 1.2 | 0.5 | 0.2 | 0.1 | 0.1 | 0.0 | | | | 7.2 |
| 8.87 | | | | 0.1 | 0.2 | 0.4 | 0.6 | 0.7 | 0.5 | 0.5 | 0.3 | 0.1 | 0.0 | 0.0 | | | | | 3.5 |
| 8.62 | | | | 0.0 | 0.1 | 0.3 | 0.3 | 0.5 | 0.6 | 0.3 | 0.2 | 0.1 | 0.0 | | | | | | 2.5 |
| 8.37 | | | | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.2 | 0.1 | 0.1 | 0.0 | 0.0 | | | | | | 0.8 |
| 8.12 | 0.0 | | | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | | | | | | | | | 0.4 |
| 7.87 | | 0.0 | 0.0 | 0.0 | | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | | | | | | | | | 0.2 |
| 7.62 | | | | 0.0 | 0.0 | | | | | | | | | | | | | | 0.0 |
| 7.37 | | | | | | 0.0 | | | | | | | | | | | | | 0.0 |
| Totals | 0.0 | 0.0 | 0.0 | 0.4 | 1.4 | 4.0 | 8.3 | 13.8 | 19.5 | 19.6 | 14.8 | 9.5 | 5.3 | 2.0 | 0.9 | 0.4 | 0.1 | 0.0 | 100.0 |

In making a translation from actual foot measurements into proposed sizes of footwear lasts, certain allowances have to be made to provide additional room in the shoe necessary to obtain proper fit and comfort. For example, normally we add 5/8 inch (15 millimeters) to the foot length to obtain the proper last length. Such other adjustments as may be made to accommodate the anthropometric data are made in shape of the last, the volume allowed for the foot in all locations within the shoe. These adjustments are part of the art of last making, of knowing how to translate all of these dimensional figures into the three-dimensional last, with enough room to assure fit and comfort as well as to determine the style and appearance of the finished shoe.

Making this allowance of needed extra room in the shoe for length, the Iranian bivariate distribution data can be converted into boot sizes as is shown in Chart XI — "Distribution of Iranian Foot Dimensions by Boot Sizes (U.S. Mil-5 Last)".

This conversion has been made in terms of the U. S. Mil-5 Last and shows the percent of men who would fall into each of the appropriate size groupings, taking into account men with all sizes of feet who were covered in the anthropometric survey. However, as has been pointed out, the small number of men on the fringes, that is those falling in the smallest 5% of sizes and the largest 5%, can be disregarded (Table II). On this basis, the population for whom the tariff of sizes should properly be provided are those shown within the marked outline.

A simpler version of this proposed tariff is shown in Table III which shows the number of sizes of boots per 1000 men which would be required to obtain proper fit under the basic ground rules and concept of fit outlined by the U. S. Army and recommended to the IIGF for the proposed new last and boot. It will be noted that this proposed tariff adds up to 21 sizes in the regular tariff. It does not provide as close fitting as is done with the U.S. Army boots where actually we use as many as 56 sizes to cover the same basic proportion of the military population. Accordingly, it represents what we consider a minimum tariff and will require careful fitting in order to obtain satisfactory results.

Whether from a logistics standpoint or the standpoint of actual care in fitting, this full range of sizes can be effectively used so each man gets the size he actually needs, cannot be determined in this Technical Summary. This is a matter which will require study in respect to supply practices in the IIGF.

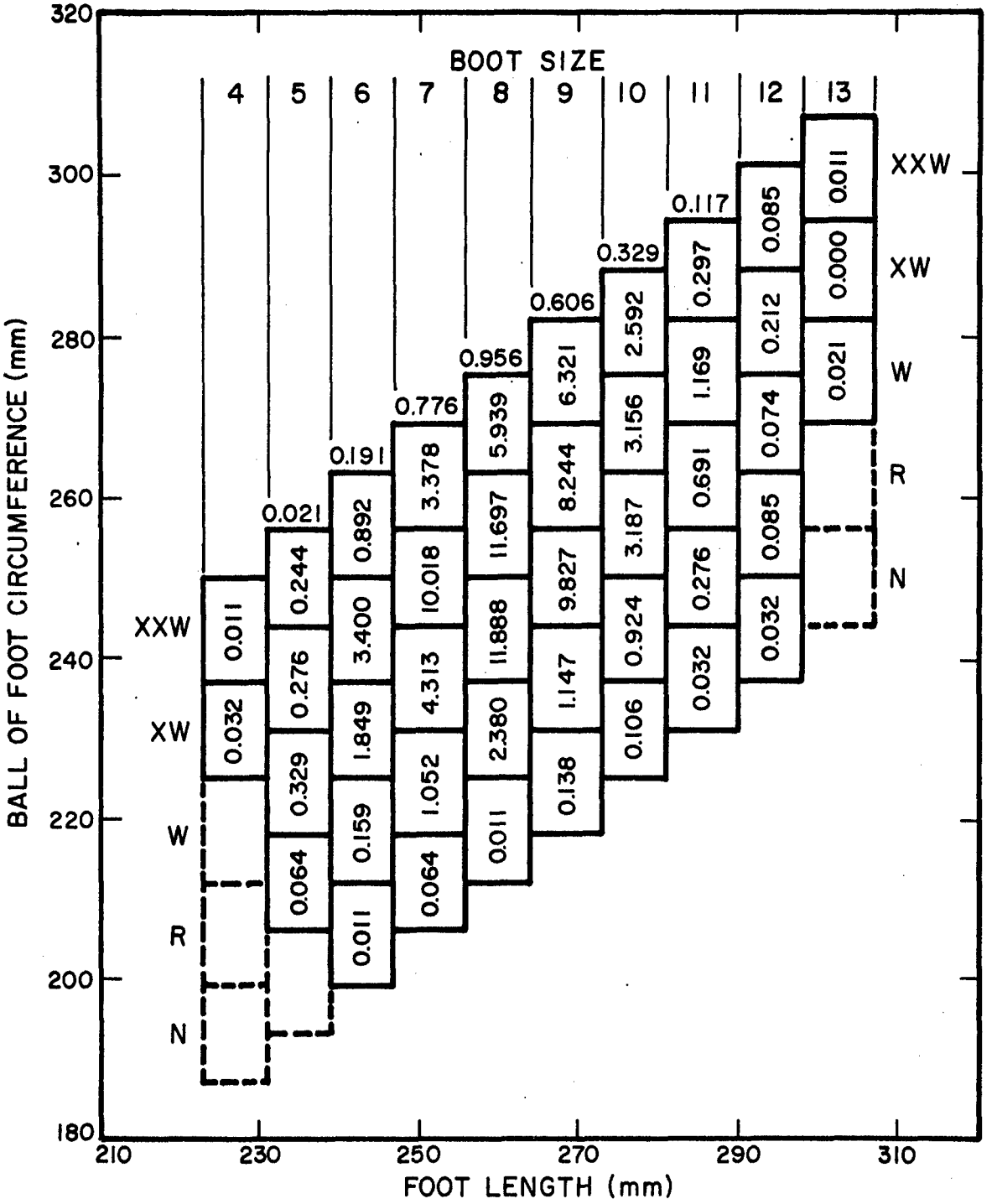



CHART XI PERCENTAGE DISTRIBUTION OF IRANIAN FOOT DIMENSIONS BY BOOT SIZES (U.S. MIL5 LAST)

TABLE II

PERCENTAGE DISTRIBUTION OF IRANIAN FEET BY BOOT SIZES

(U.S. MIL-5 Last)

| Boot Length | Boot Width | | | | | | |
|---|---|---|---|---|---|---|---|
| | N | R | W | XW | XXW | No fit | Total |
| 4 | | | | .032 | .011 | | .043 |
| 5 | | .064 | .329 | .276 | .244 | .021 | .934 |
| 6 | .011 | .159 | 1.849 | 3.400 | .892 | .191 | 6.502 |
| 7 | .064 | 1.052 | 4.313 | 10.018 | 3.378 | .776 | 19.601 |
| 8 | .011 | 2.380 | 11.888 | 11.697 | 5.939 | .956 | 32.871 |
| 9 | .138 | 1.147 | 9.827 | 8.244 | 6.321 | .606 | 26.283 |
| 10 | .106 | .924 | 3.187 | 3.516 | 2.592 | .329 | 10.654 |
| 11 | .032 | .276 | .691 | 1.169 | .297 | .117 | 2.582 |
| 12 | .032 | .085 | .074 | .212 | .085 | | .488 |
| 13 | | | .021 | | .011 | | .032 |
| No fit | | | | | | .011 | .011 |
| Total | .394 | 6.087 | 32.179 | 38.564 | 19.770 | 3.007 | 100.001 |

## TABLE III

## PROPOSED BOOT TARIFF

(per 1000 items)

| Boot Length | Boot Width R | W | XW | XXW | Total |
|---|---|---|---|---|---|
| 6 | | 19 | 35 | 9 | 63 |
| 7 | 11 | 44 | 104 | 43 | 202 |
| 8 | 25 | 124 | 122 | 71 | 342 |
| 9 | 11 | 102 | 85 | 71 | 269 |
| 10 | 9 | 33 | 36 | 27 | 105 |
| 11 | | 7 | 12 | | 19 |
| Total | 56 | 329 | 394 | 221 | 1000 |

If it proves practical from a logistic standpoint and the care to be exercised in fitting at the point of issue, some additional sizes could be added to pick up some of the individuals in the size groupings shown on Table II who have not been included in the proposed tariff in Table III.

This proposed tariff in Table III, it should be noted, has been proposed as a minimum tariff.

## Direct-Molded-Sole Construction

The direct-molded-sole construction for footwear was developed during the 1950's for men's footwear, utilizing new, high-pressure, vulcanizing equipment capable of providing a very strong bond between the sole and the upper of boots and shoes. In this type of construction, the shoe upper is placed into position over the uncured rubber in the mold, the two brought together under pressure, and the rubber vulcanized in place directly to the upper. Low pressure equipment of this type had been used for many years for children's and women's shoes. For men's heavy duty shoes and boots, however, the newer type of equipment was needed.

This type of shoe construction has appealed to all Western armies for many reasons, but particularly because it eliminates the sole stitching of the typical Goodyear-welt construction which tends to give way in field operations due to abrasion and cutting of the thread, with resulting sole separation. Even change-over from cotton or linen thread to polyester thread does not overcome this problem because the thread soon is worn through, and the adhesive is not sufficient to hold the sole to the boot.

Experience of U. S. troops in the Korean War indicated that a better construction was absolutely essential. Accordingly, intensive study of the DMS process was undertaken.

The first DMS boots to be produced for any army were the jungle boots furnished to U. S. troops in Southeast Asia. The record established by that boot has been excellent. It has been regarded almost universally by U. S. troops as the best item provided to them.

The U. S. leather combat boot worn on garrison duty and in temperate climates has now been converted to the DMS construction.

For terrain such as exists in Iran, which is characterized by wind-eroded rocks and sand, the DMS construction is certainly to be preferred to the stitched sole Goodyear-welt construction. It can be conservatively stated that the DMS boot will outwear a Goodyear-welt stitched sole boot by two to one under field conditions if an abrasion-resistant soling compound is used.

Also, in terms of initial cost, the DMS boot in the U.S., England and Canada has been found to be less expensive.

It should be understood, however, that the DMS process is a quite sophisticated system, and requires considerable capital investment in molding equipment and in the molds. It also requires the services of a chemical laboratory and support by a rubber manufacturer who can develop and test the rubber formulations which are used with the vulcanizing equipment. For this reason, it would be quite inadvisable for the Iranian Government to attempt to establish a government plant to make boots by this process.

Such action would be quite unnecessary, since there already exists in Iran an industrial concern having extensive experience in producing this kind of footwear as well as the necessary equipment. A brief inspection of the producing facilities of Melli Industries indicates clearly that this firm could manufacture DMS footwear of high quality, over specifications based on those now used in the U. S. Their equipment is modern and their technology, both in shoe-making and in rubber formulation would be quite adequate for the Iranian Army's needs.

It has been suggested that a quantity of DMS boots made by this concern be given a troop test by the IIGF. These boots could be made over the US Mil-5 last with which this firm is already equipped. (See illustration).

## Ventilating Insoles

The ventilating insole for combat footwear was invented for the U. S. Army for use by our troops during the North African campaign in World War II to provide foot comfort.

The principle involved is that the ventilating insole separates the sole of the foot somewhat from the insole of the boot with an air layer. This encourages evaporation of the insensible perspiration on the sole of the foot, thereby lowering the temperature of the skin a few degrees. Also it serves as a cushioning layer for the foot and assists in moving air in and out of the boot.

The ventilating insole is now used in both of the U. S. combat boots, by the United Kingdom, Canada, and Australia. It is made from polypropylene or vinylidene chloride monofilament, woven into a loose mesh with several layers welded together at the outer edge.

## Conclusions

1. The anthropometric survey has shown that the feet of Iranian soldiers are proportional to those of U. S. soldiers, in basic shape, even though they are about a size shorter and about two U. S. widths wider. Since the U. S. Mil-5 footwear last was itself based upon anthropometric measurements in the study, "Foot Dimensions of Soldiers", and since basic sizes for the two armies run with reasonable consistency through the entire range of the population, the U.S. Mil-5 last should provide a good basic last for Iranian combat footwear, with adjustment of the tariff for the differences in foot length and breadth.

2. A larger range of sizes would be desirable if Iranian soldiers are to be fitted in accordance with minimum fitting requirements for foot health and comfort.

3. Boots made over the direct-molded-sole construction should prove more durable, longer wearing and of lower cost in the long run than boots made from the Goodyear-welt stitched construction.

4. Ventilating insoles should be worn in combat footwear in hot climates for the additional foot comfort they can provide.

## Recommendations

That a troop test be made by troops outfitted with DMS boots made over the U.S. Mil-5 last, in the recommended tariff of sizes, to determine fitting characteristics, comfort and durability. The test should include ventilating insoles.

# APPENDIX I

## PROPOSED PLAN OF TEST
## OF

## DIRECT-MOLDED-SOLE BOOTS MADE OVER THE U.S. MIL-5 LAST
## BY THE IMPERIAL IRANIAN GROUND FORCES

# PROPOSED PLAN OF TEST
# OF
# DIRECT-MOLDED-SOLE BOOTS MADE OVER THE U.S. MIL-5 LAST
# BY THE IMPERIAL IRANIAN GROUND FORCES

## 1. Quantity Recommended

The test should be made with not less than 500 pairs of boots, distributed over the full range of proposed sizes in accordance with the recommended tariff. If possible, the boots should be issued to a single unit engaged in active field activities, or to not more than two units, to facilitate administration of the test.

## 2. Duration of the Test

The test should be continued for at least six months, preferably nine to twelve months, so as to obtain response from the wearers over the entire seasonal cycle. To the maximum extent possible, troops selected for wearing the boots should accordingly be expected to remain in the military service for the duration of the test. Boots should not be passed on to other test subjects, due to possibility of transferring foot infections, "athlete's foot", or inability of a second person to achieve the same degree of fit.

## 3. Initiation of the Test

a. Orientation — Troops selected for the test should be given a brief orientation by the Test Officer concerning the purpose of the test and the importance of proper foot hygiene.

b. Medical Examination of the Test Subjects

Prior to the test fitting of the test items, the medical personnel assigned to conduct the test and to make clinical examinations of the feet of the test subjects, will conduct a controlled observation of the test subjects to determine the condition of their feet while wearing their presently issued footwear. Any of the following lesions or characteristics are to be noted on charts for each test subject at the point where they occur, with the date of the observation, so that comparison can be made at the conclusion of the test after wearing the new boots:

Blisters (B1) or similar abbreviated code
Callouses
Corns
Ingrown Nails

Painful Areas of the feet
Pronation
Fallen Arches
Deformities of the Feet
Any other special conditions

The degree of the characteristic shall be marked in accordance with this scale:

0 — Absence of an adverse condition
1 — Slight presence of condition (at location)
2 — Moderate presence of condition (at location)
3 — Severe presence of condition (at location)

It should be kept in mind that this same examination and recording is to be made at each phase of the test, so that record sheets should be properly dated, and numbered serially so that statistical data can be obtained from the test.

4. Issue of the Footwear

One pair of boots and at least three pairs of new socks will be issued to each test subject. Boots should be marked with paint or "magic marker" with separate numbers so that each soldier will, at all times, be able to identify his pair of boots. Check will be made periodically during the test to insure that socks are washed frequently and that no socks with darns or other repairs are being worn. Where necessary, fresh socks should be issued to replace socks that develop holes, so as to avoid the causing of blisters from improper sockgear.

a. Sock Fitting and Sizing

A sock fitter will issue the socks to make sure that the right size is provided. This should be the size normally worn by the test subject. The size shall be recorded on his data sheet.

b. Inspection of Test Boots

Prior to test fitting, each pair of the test boots will be carefully examined and inspected for the presence, if visible, of any defects which might interfere with proper fitting or comfort. Any such defective item will be withdrawn from the test lot, and identified as unsuitable for use in the test.

c. Shoe Fitting

The test subject, while wearing his fitted pair of socks, will be given the estimated proper size of boot to try on. At least two different sizes will be tried on to ascertain the degree of fit before determining his proper size. Since right and left feet are seldom the

same length or size, both boots should be tried on for fit and laced up at least five eyelets. Fitting will be done in accordance with the fitting instructions provided elsewhere.

If the shoe fitter and the test subject agree on the fitted size, this size will be entered on the data form, and initialed both by the shoe fitter and the test subject.

d. Ventilating Insoles

Ventilating insoles of proper size for the issued boots will be provided with the boots and will be worn in the boots when they are being fitted. They will be worn at all times during the test of the boots, and will be replaced as necessary when they become badly worn and no longer usable. An extra supply of ventilating insoles, allowing at least two pairs for replacement will be held in reserve for this purpose, and will not be allowed to be worn by other than the test subjects in their test boots.

5. Supervision of the Test

Conduct of a test of this kind can prove difficult principally from the standpoint of control. A Test Officer must be assigned at each of the locations where the test is being conducted, if with more than one group, and must have made available to him at least two enlisted personnel who can assist in keeping track of the boots and the test subjects, and see that the questionnaires are administered on the scheduled dates. This will not require full time assignments, but these individuals will be responsible for the successful completion of the test and must be made to understand their responsibility.

The most important aspect of this test must be the medical examination of the feet of the test subjects by a qualified medical officer. The medical officer may also be the Test Officer. If this can be arranged, it would be desirable.

The medical officer must be available on call at any time any test subject reports a foot problem. His feet should then be examined for the source of the problem, and a record made on the standard test data sheet, with the medical officer's observations as to the nature of the difficulty, its probable cause, degree, and whether the test subject should be allowed to continue with the test or be withdrawn from being a test subject.

In addition, and most important, the medical officer will conduct an examination of the feet of all test subjects at the close of each phase when the periodic reports are made on the test, as listed below. The general procedure should be that the medical officer will establish himself in a suitable location near the test group, and the men should be directed in to him, at which time, they should remove their boots and socks, and permit examination of their feet for any disabilities or sources of discomfort which they may report. The clerk should complete the record for each man, date it, and hold it for ultimate statistical analysis.

The Test Officer should also be responsible to see that during the various phases of the test the men carry out tasks which will place the kind of strain upon them that they would experience if they were in combat. This may involve periodic marches over various types of terrain for distances equivalent to eight to twelve miles, wearing full combat loads and carrying their weapons and full loads of ammunition. Examination of the feet of the men upon completion of such marches is most important. Such marches could be scheduled at the close of each test period prior to examination of the feet and administration of the test questionnaires.

6. Schedule for the Test

If the test cannot be continued for more than six months, then the following schedule for examinations and interviews should be followed:

Phase 1. — Initial Examination before the boots are issued.
Phase 2. — Examination after two weeks of wear in normal barracks duty.
Phase 3. — Examination after six weeks of wear, including at least one stress march.
Phase 4. — Examination after 12 weeks of wear, including at least one stress march.
Phase 5. — Examination after 24 weeks of wear, including at least one stress march.

This would bring the test to a conclusion, if the test period is to be for six months only.

If the test can be continued for a longer period, each additional twelve weeks of wear should be considered an additional Phase.

7. Records to be Kept

A diagram sheet of the feet will be provided to record foot difficulties. A sample of such a diagram is attached on the back of the Medical Examination Form.

8. Test Questionnaires

Sample test questionnaires are also provided herewith. They should be administered to each man individually by one of the enlisted assistants to the Test Officer. The questions should be asked of each man in a closed area where other test subjects cannot overhear the replies. It is important for validity of the test that the questions should be asked in a totally objective way, so as not to prejudice the test subject's answers.

The test results will be invalid if such questions are asked as, "You didn't like the boots, did you?" or the opposite, "You liked the boots, didn't you?" Questions with a bias like this, especially if asked by a superior will make it impossible to get factual answers. Also test subjects should be discouraged from discussing among themselves how they answered the various questions.

## 9. Examination of the Boots for Durability

At the conclusion of each Phase, the boots should be examined for their physical condition. Boots which show any marked failure, such as sole separation, should be removed from the test, and the test subject either issued another pair or dropped from the test. Minor failures should be noted and made a matter of record.

At the conclusion of the test, the boots should be examined by a competent Board and determination made as to the amount of useful service life remaining in them. Degrees of failure of the boots, total number of failures, etc., should be recorded in the final report of the test.

# APPENDIX II

## PROPOSED INSTRUCTIONS FOR THE FITTING OF FOOTWEAR

## IMPERIAL IRANIAN GROUND FORCES

## PROPOSED INSTRUCTIONS FOR THE FITTING OF FOOTWEAR

## IMPERIAL IRANIAN GROUND FORCES

1. Definition of Proper Fit

Proper fitting in shoes is more important than in almost any other item worn by a soldier. Perfect fit is difficult to achieve because of the wide variation in the feet of different people., and the fact that one foot is often slightly longer than the other.

Proper fit is achieved when the foot is held securely in the boot from the lacing at the instep to the heel, but with sufficient room in the forepart of the boot for the foot to be free from restriction.

Footwear fits properly when it is not:

(1) So tight in the toe region as to be uncomfortable

(2) So loose in the vamp as to produce abrasion from creasing of the upper leather.

(3) So loose from the heel to the instep as to allow the foot to move independently of the shoe when walking.

2. Fitting

a. General — When try-on size has been determined, make sure the heels are positioned well back into the footwear. A kickboard should be used so that the individual can get his heels well back into the footwear by kicking the heels against the kickboard. Boots should be laced through not less than five lower eyelets and tied when check for fit is made.

b. Checking Length — Check each item of footwear separately for length by trying on both boots. Make sure that there is a clearance for space of at least 1/2 inch between the end of the longest toe and the end of the footwear. At least two sizes should be tried on before determination is made that the boot is the correct size.

c. Checking Width — Check each item of footwear separately for width. Make sure that the foot fills the footwear without excessive tightness. Do not fit too snugly. However excessive fullness should also be avoided. It is better to allow a light fullness of the leather at this point than to fit too snugly.

d. Checking Fit with Footwear Flexed — Checking the fit of footwear on the feet of an individual who is standing erect and immobile is important, but the footwear must also conform to the contours of the flexing or mobile foot to be completely comfortable. There are two final procedures which should be followed in checking the fit of footwear under conditions of flexing.

(1) Have the individual do a "full knee bend" and, while in this position with the heels off the floor, recheck width and length. The ball joint should be in line with the break in the shoe. The leather should be snug, but not tight across the vamp, and the great toe should still be at least 1/2 inch from the end of the shoe.

(2) Have the individual walk a minimum of six steps, and obtain his opinion of comfort prior to making a final decision as to correctness of fit.

Experience has shown that the dimensional tolerances which a man should have between the foot and the shoe may depend upon the activity of the wearer, the climate to which he is exposed, the materials of which the shoe is made and the rigidity of its construction. Also boots fitted in the morning hours should have a looser fit than if fitted in the late afternoon, since the foot of an active man will increase in width and length between the time he gets up in the morning and the end of an active working day.

3. Responsibility

a. Commanders at all echelons are responsible for insuring that all personnel in their commands are equipped with properly fitted footwear.

b. The installation quartermaster, or other designated officer, is responsible for proper fitting of footwear at the time of issue or sale.

NOTE: These Proposed Instructions for the Fitting of Footwear are based upon U.S. Army Iterim Training Circular QM-14, "Fitting of Military Footwear", dated September 1963, which may be consulted for further detailed procedures, if desired.

TEST QUESTIONNAIRE

BOOT TEST

IMPERIAL IRANIAN GROUND FORCES

Test Site _____ Date _____

Phase 1 2 3 4 5 Interviewer _____
(Circle one) (Initials)

Test Subject's Name _____
(First) (Mi) (Last)

Rank _____ Organization _____

Primary Duty _____

Questions:

1.a. Approximately how many days each week have you worn your test boots during this test period?

Every day _____ 6 days each week _____

5 days each week _____ Less than 5 days _____

b. If not every day, then why didn't you wear the boots every day?

_____

_____

2. a. How would you rate this type of combat boot for overall field use? (check one)

Very satisfactory
Fairly satisfactory
Fairly unsatisfactory
Very unsatisfactory

b. Why do you feel this way? (If "Unsatisfactory", explain in detail).

_____

_____

_____

3. a. After wearing these combat boots, do you feel that they are: (check one)

Very comfortable
Fairly comfortable
Fairly uncomfortable
Very uncomfortable

b. Why do you feel this way? (If "Uncomfortable", explain in detail).

_____

_____

_____

4. Did you wear the boots regularly with the ventilating insoles?

Yes No

b. Did you find the ventilating insoles comfortable? (check one)

Very comfortable
Fairly comfortable
Fairly uncomfortable
Very uncomfortable

5. Do you feel that you were given a good fit in these boots? (Check one)

Very good fit
Fairly good fit
Fairly poor fit
Very poor fit

If any degree of "poor fit" is checked, then ask: "What seemed to be wrong with the fit? (Explain in detail)

6. What do you like about this type of combat boot?

7. What do you dislike about this type of combat boot?

8. a. How would you rate these boots with regard to durability for a field boot? (check one)

Sufficiently durable
Not sufficiently durable

b. If "not sufficiently durable" is checked, then ask: "Why do you consider these boots not sufficiently durable?

# MEDICAL EXAMINATION RECORD

## BOOT TEST

## IMPERIAL IRANIAN GROUND FORCES

Phase of Test _____ Date _____

Name _____ Organization _____

Size of Boot _____ Size of Socks _____

History of Foot Disorder, other than indicated below: _____

_____

Appearance of Foot at Time of Examination:

Grade by the following scale:

0 — Absence of an adverse condition
1 — Slight presence of condition (at location marked)
2 — Moderate presence of condition (at location marked)
3 — Severe presence of condition (at location marked)

(Identify on the chart by a code abbreviation)

Blister _____

Callous _____

Corns _____

Ingrown Nails _____

Painful area of the foot _____

Pronation _____

Fallen Arches _____

Deformity of the foot _____

Any other special condition _____

General observations on the condition of the soldier's feet _____

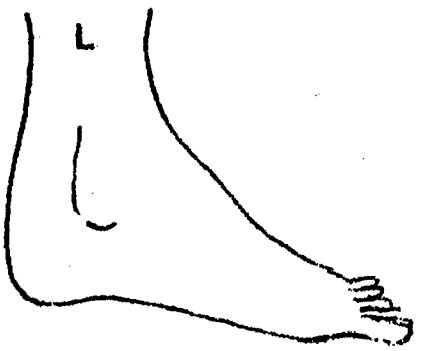
Signature _____

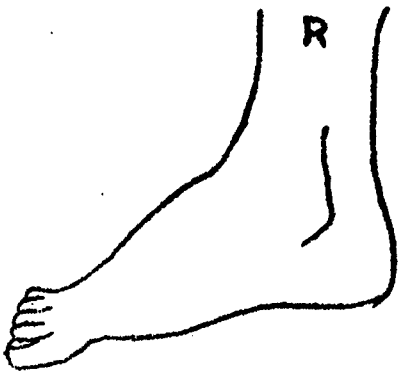
Medical Officer

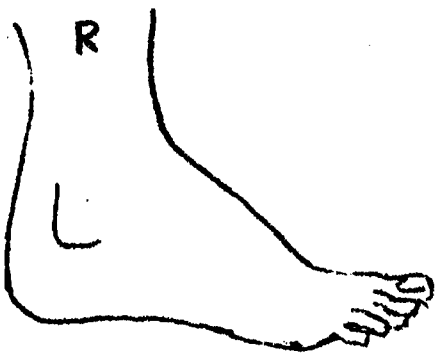
Name _____ Date _____

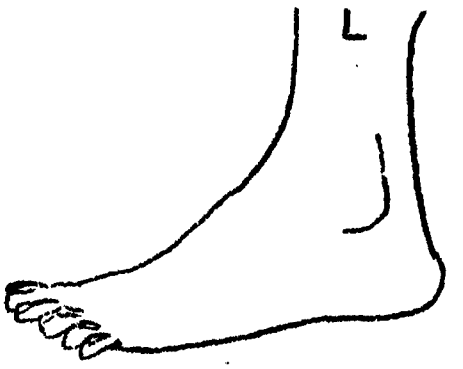
Phase _____

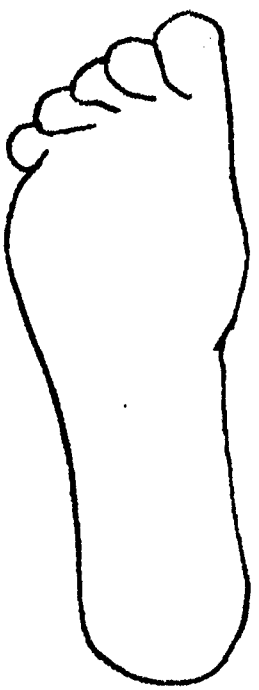
LOCATION OF ISOLATED LESION OR DISCOMFORT

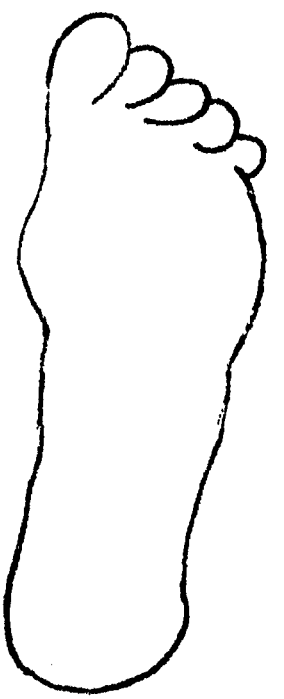




Locate by Appropriately Placed Abbreviation with Number Representing Severity

# APPENDIX III

## BASIC SPECIFICATION FOR A DMS BOOT

July 1971

# BOOT, MILITARY. LEATHER, BLACK, DIRECT MOLDED SOLE

## 1. SCOPE

1.1 This specification covers the requirements for a military leather boot with a full cleated direct molded tread sole and heel and grain out upper leather. It also provides for the insertion of a ventilating insole.

1.2 Sizes.- The boots shall be provided in the following sizes and widths:

| | Boot Width | | | |
|---|---|---|---|---|
| Boot Length | R | W | XW | XXW |
| 6 | | X | X | X |
| 7 | X | X | X | X |
| 8 | X | X | X | X |
| 9 | X | X | X | X |
| 10 | X | X | X | X |
| 11 | | X | X | |

## 2. REQUIREMENTS

2.1 Patterns, dies, lasts and molds.-

2.1.1 Patterns and dies.- The patterns, markers, and cutting dies shall conform to the design of the standard sample and shall consist of the following:

| Component parts | | Markers |
|---|---|---|
| Vamp | Eyelet stays | Back stay |
| Quarters | Vamp lining (cloth) | Vamp |
| Counterpocket | Insole | Quarter |
| Tongue | Box toes | |
| Top facing | Insole (ventilating type) | |
| Back Stay | | |

2.1.2 Lasts.- The boots shall be lasted on an approved last.

2.1.3 Molds.- The molds shall be made so as to produce a sole conforming to fig. 1.

2.2 Material.-

2.2.1 Leather.- All leather components covered by this specification shall contain 0.18 to 0.70 percent paranitrophenol fungicide to prevent mildew deterioration of the boots during use and storage.

2.2.1.1 Upper Leather.- The leather for the vamp, quarters, counter pockets and back stays shall be chrome tanned, embossed corrected grain cattlehide processed with lubricating materials containing less than 10 percent hydrocarbon mineral oil, based on the moisture-free weight of the lubricating materials. The color of the grain side shall be black. The thickness of the cut parts shall be as specified in 2.3.1. The leather shall contain not less than 6.0 percent nor more than 14.0 percent chloroform soluble material on a moisture free basis. This requirement is important to assure a strong bond of the outsole to the upper.

2.2.1.2 Gusset leather.- The leather for the tongues, eyelet stays and top facing shall be cut from chrome tanned, embossed, corrected grain cattlehide. The color of the grain side shall be black. The thickness of the cut parts shall be as specified in 2.3.1.

2.2.1.3 Leather insoles.- The insoles shall be cut from full grain, chrome retan or vegetable retan cattlehide and shall be 7 irons in thickness (NOTE: 1 iron=1/48") and shall conform to the approved paper insole patterns. A heavy leather insole is highly desirable for retention of life of the boot and for comfort.

2.2.1.4 Counters.- The counters shall be made from leather, leatherboard or shoeboard. They shall be full molded on forms (molds) conforming to the last. The lasting flange shall be 1/2 to 9/16 inch wide. The thickness of the counter shall be 5-1/2 to 6-1/2 irons thick when measured at a point 3/4 inch from the flanged surface and 3/4 inch from the center back seam. They shall have a bottom scarf 1/2 ± 1/16 inch wide, a top scarf 5/8 ± 1/16 inch wide and an end scarf 7/8 ± 1/16 inch long.

2.2.2 Fabrics.-

2.2.2.1 Backseam tape.- The tape shall be 1/2 inch wide preferebly 17 ounces per gross yards with a minimum breaking strength of 42 pounds.

2.2.2.2 Box toes.- The box toe fabric shall be a woven base flannel or a processed (needled) fabric impregnated with a pyroxylin or polystyrene compound, .0875 ± .0075 inch thick.

2.2.2.3 Vamp lining.- A desirable fabric for the vamp lining would be a 10 ounce per square yard natural or bleached cotton 3/1 twill with a breaking strength of not less than 145 pounds warp and 125 pounds in the filling. The starch and protein content, including chloroform-soluble and water-soluble material should be not greater than 15.0 percent based on the weight of the cloth.

2.2.3 Metal.-

2.2.3.1 Steel Shank.-- The steel shank shall be constructed from 19 gage cold rolled carbon steel shaped to conform to the arch of the last. The shank shall have two prongs 6/32 inch long upward into the filler and two prongs 3/32 inch to 5/32 inch long downward into the innersole.

2.2.3.2 Tacks and staple wire.- The heel seat lasting tacks shall be steel or brass. Steel tacks or staples shall be used for side lasting and toe lasting.

2.2.3.3 Eyelets.- The eyelets shall be brass or aluminum, 0.016 ± 0.0015 inch thick, with roll setting barrel and shall have a 0.480 to 0.496 inch outside diameter of flange, a 0.295 to 0.299 inch outside diameter of barrel, a 0.234 to 0.240 inch diameter of hole before setting and a 0.224 to 0.236 inch overall length. The eyelets shall be top roller coated or tumble coated with not less than two coats of black enamel.

2.2.4 Rubber.- A black non-marking abrasion resistant soling material would be one compounded utilizing the following materials in its formulation: (a) Base rubber: A copolymer of butadiene and acrylonitrile blended with approximately 30 percent by

weight of polyvinyl chloride; (b) Accelerators: A combination of benzothiazyl-disulfide, 2-mercaptobenzo-thiazole, zinc dimethyl dithiocarbamate, di-ortho-tolyl-guanidine; (c) Antioxidants and antiozonants: Reaction product of diphenylamine and diisobutylene and a mixture of selected waxes; (d) Plasticizers and softeners: Terpene resin acid blend and methylated tall oil ester and dioctyladipate; (e) Reinforcing material: Hydrated silica; (f) Coloring material: Carbon black, not more than 5 parts by weight; (g) Vulcanizing agent: Sulfur; (h) Activators: Stearic acid and zinc oxide. A suggested compound recipe as shown in 3.1. The rubber outsole and heel assembly shall have a bond strength of not less than the equivalent of 135 pounds. This figure is based upon the U. S. test in which the force necessary to separate the outsole assembly from the upper is measured on a tensile strength apparatus. The sole and heel when vulcanized should possess properties equal to or better than the following as called for in the U. S. specification.

a. The volume swell shall be not greater than 60 percent in medium No. 6 fuel.
b. The abrasive index shall be not less than 80 before and after aging for 70 hours at 100 ± 1° C.
c. The hardness shall be 70 ± 5, after accelerated aging for 70 hours at 100 ± 1° C.
d. The hardness shall change no more than 10 points from the original.

2.2.5 Thread.- The thread shall be a good commercial grade filament nylon thread, 3 ply, and a breaking strength of 8.5 pounds. The color shall be black.

2.2.6 Miscellaneous materials.-

2.2.6.1 Heel fillers.- The heel fillers shall be made of fiberboard or other suitable material that does not affect vulcanization of the heel.

2.2.6.2 Adhesives.- The sole adhesive for vulcanizing the rubber sole to the leather upper shall be compatible to the soling material.

2.2.6.3 Laces, nylon (material).- The laces shall be nylon or blended nylon. The tips shall be made from nylon sheet or film. As an alternate the tips may be heat molded. The color of the laces and tips shall be black. The length of the lace, including tip shall be sufficient to permit lacing and tying of the finished boot.

2.2.6.4 Insole, ventilating.- Each pair of boots shall be fitted with one pair of ventilating insoles.

2.3 Construction.-

2.3.1 Cutting uppers.- The uppers shall be cut from grain out leather. The thickness of the cut parts shall be as follows:

| Part | Thickness (ounces) Minimum | Maximum |
|---|---|---|
| Vamp | 5 | 6 |
| Quarter | 4-1/2 | 6 |
| Outside, counterpocket | 4 | 6 |
| Eyelet stay and top facing | 2-1/4 | 3-1/4 |
| Backstay | 4 | 6 |
| Tongue | 2-3/4 | 3-1/2 |

2.3.1.1 Skiving of upper leather.- Each scarf shall be sufficient to produce a smooth even fitting. All skiving shall be on the flesh side.

2.3.2 Marking.- The inside quarter of each boot shall be marked on the grain side with the correct size and width.

2.3.3 Upper Leather fitting.- Fitting shall be accomplished in accordance with line marker patterns. The quarter closing shall be done with one row of stitching; backstaying stitched to quarters with two rows; counterpocket to quarters stitched with 2 rows; tongue to vamp throat stitching with double row; tongue to eyelet row, eyelet facings and top facing stitching with single row on each side; and vamp to quarter stitching shall be done with four rows. All upper fitting stitching shall be 8 to 10 stitches per inch. The uppers shall be laced for lasting, with sufficient amount of eyelets on each quarter, evenly spaced from blucher nose to top of quarter.

2.3.4 Lasting.- Uppers may be conditioned by any suitable means except they shall not be dipped into water. Insoles shall be tacked to the last. The counters shall fill the counterpockets. The counter shall be seated to the insole and anchored with a tack near the end of the counter. The tack shall be driven through the counter pocket and insole and clinched against the heel seat plate. Counters shall be well cemented on both sides. The flesh side of the leather counter shall be towards the inside of the boot. 1/2 + 1/6 inch of the counter shall be turned over the last at the bottom. The box toe shall be conditioned and inserted between the vamp lining and the vamp. A light coating of any adhesive shall be applied between the vamp and vamp lining rearward of the box toe. Uppers shall be assembled to the lasts in a manner to provide for a wiped-in-heel seat of not less than 7/16 inch nor more than 3/4 inch. Uppers shall be drawn over the lasts with proper tension to assure that the quarters at the blucher points and the vamps are down to the last, and that the blucher noses are even. The heel seat shall be wiped-in, tacked and shall be flat and free from wrinkles. The toe shall be firmly and smoothly wiped-in and securely attached by staples or tacks. The sides shall be cemented before or in conjunction with side lasting and stapled or tacked. The staples and tacks shall hold the upper in place through the vulcanization operation.

2.3.5 Tack pulling.- All the insole tacks shall be removed with care taken that no broken tack points remain. This is most important and all boots should be inspected to make sure that tacks have been removed.

2.3.6 Bottom roughing.- The edges of the lasted uppers shall be roughed with cylindrical steel brush.

2.3.7 Bottom adhesion.- A liberal amount of adhesive shall be applied to the roughed area and to the exposed part of the insole and the shank. After allowing the adhesive to dry, a second coat of the same adhesive shall be applied to the same roughed area and allowed to dry.

2.3.8 Relasting.- The boots shall be relasted using proper size and width metal lasts on the direct molded sole machine. The steel shank shall be inserted on the insole.

2.3.9 Sole and heel construction.- The outsole biscuit including the heel shall be cut from a calendered or extruded single biscuit of suitable thickness to fill the sole and heel cavity of the molds.

2.3.10 Sole and heel molding.- The outsole and heel shall be directly molded to the upper of the boot. The equipment shall exert a minimum pressure of 250 pounds per square inch on the compound. The sole and side molds shall be heated to a constant heat of 149° to 163° C (300° to 325° F) for a dwell time of sufficient duration to ensure correct vulcanization in Iranian climate. The boots shall be molded with the use of metal lasts. After removal from the molding machine, the flash edges shall be removed. Tacks and nails, that have been left protruding through or around the insole and cannot be pulled out, shall be cut close to the surface.

2.3.11 Finishing.- The boots shall be cleaned and all thread ends shall be trimmed. The boots shall be mated. A lace shall be inserted through the top eyelet of the outside quarter of each boot, and the two laces shall be tied together. One ventilating insole shall be inserted in each boot.

2.4 Workmanship.- The finished boots shall be of good quality and grade.

3. NOTES

3.1 Rubber compound recipe used in leather DMS boots.-

| Materials | Parts by weight |
|---|---|
| 70/30 Nitrile/Polyvinylchloride resin blend | 100 |
| Terpene acid resin | 3 |
| Diphenylamine/diisobutylene reaction product | 1 |
| Hi Sil 233, Hydrated Silica | 45 |
| Easy processing carbon black | 3 |
| Zinc oxide | 3 |
| Stearic acid | 1.5 |
| Methylated tall oil ester | 20 |
| Mixture of selected waxes | 1 |
| 2-mercaptobenzathiozole | 1.5 |
| Benzathozole disulfide | 0.5 |
| Di-ortho-tolylguanidine | 0.5 |
| Zinc-dimethyldithiocarbamate | 0.5 |
| Sulfur, spider | 1.5 |

3.1.1 Cement compound recipe.- Masterbatch

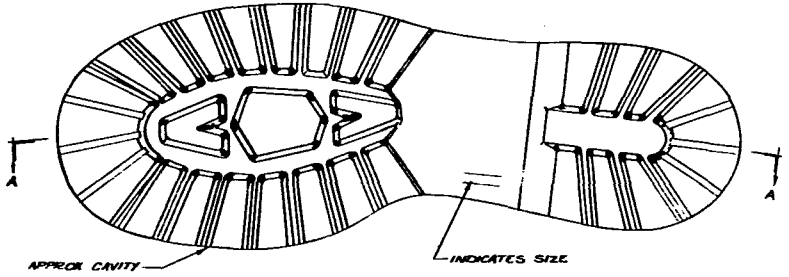
| Materials | Parts by weight |
|---|---|
| Butadiene/acrylonitrile, high acrylonitrile content | 100 |
| Dephenylamine/diisobutylene reaction product (antioxidant) | 1.5 |
| Zinc oxide | 10 |
| High abrasive oil furnace carbon black | 40 |
| Stearic acid | 1 |
| Para-coumarone-idene resins | 15 |
| Phenol-formaldhyde thermosetting resin | 40 |
| Total | 207.5 |

| Materials | Two parts cement/Parts by weight | |
|---|---|---|
| | A | B |
| Masterbatch | 207.5 | 207.5 |
| 2-mercaptobenzathiozole | 5.0 | - |
| Benzothiazole disulfide | 1.0 | - |
| Di-ortho-tolylguanidine | 1.0 | - |
| Sulfur, spider | - | 1.5 |
| MEK, Methyl ethyl ketone | 645 | 639 |

Mix A & B in equal parts before using.

## DESIGN DETAILS

LAST: REFERENCE NO U.S. MIL 5
SIZE RANGE 3-14, INCLUDING HALF SIZES
LATHE MODEL SIZES 5
GIVE SIZES GRADED FROM MODEL
FITTING XN-N-R-W-XW
SPECIFY GRADE OF LAST BOTTOM PATTERNS TO POINTS GEOMETRIC
IMPORTANT: INSOLE & BACKER SHAPES MUST BE IDENTICAL WITH LAST BOTTOM SHAPES.
HEIGHT OF LAST 11 INCHES LAST HEATING NOT REQUIRED
SIZE 8A
HEEL PITCH .750 (ALL SIZES AND WIDTHS)
TOE SPRING .663 (GRADE OF TOE SPRING .013±.004 BETWEEN WHOLE AND HALF SIZES AND .022±.004 BETWEEN XN-N-R-W-XW)



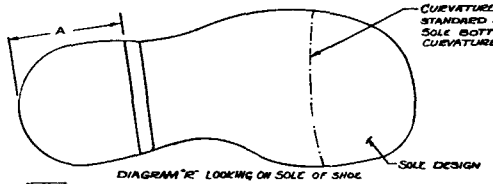
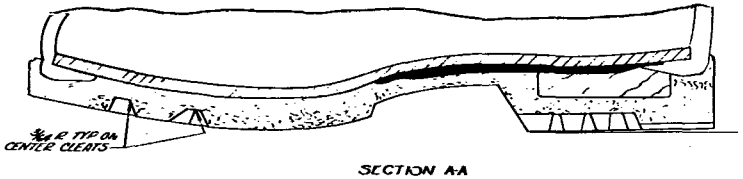




DIAGRAM "R" LOOKING ON SOLE OF SHOE




SECTION A-A

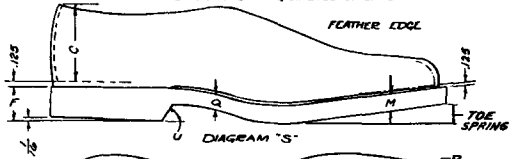



DIAGRAM "S"

| SOLE & HEEL SUBSTANCE - SEE DIAGRAMS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SOLE SUBSTANCE MEASURED AT WELT EDGE | SIZE | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
| SOLE M | | ◄ | | | | | | 3 ± 1/64 | | | | | ► | |
| WAIST Q | | ◄ | | | | | | 3 ± 1/64 | | | | | ► | |
| HEEL HEIGHT F | | ◄ | | | | | | 1 1/4 ± 1/32 | | | | | ► | |
| HEEL LENGTH A (AFTER SCOURING) | | | | | | | | 3 1/4 | GRADUATED 3/64 BETWEEN WHOLE AND HALF SIZES | | | | | |
| BREAST ANGLE U | | ◄ | | | | | | 60° | | | | | ► | |
| WELT WIDTHS ● FOREPART P | | ◄ | | | | | | 7 ± 1/32 | | | | | ► | |
| WAIST O | | ◄ | | | | | GRADUATING | | | | | | ► | |
| SEAT N | | ◄ | | | | | | 3 ± 1/32 | | | | | ► | |
| COUNTER HEIGHT C | | | | | | | | | | | | | | |

● WELT WIDTHS ARE MEASURED TIGHT AGAINST UPPER DIMS GIVEN SCOURING. WHERE WELT WIDTHS VARY NORMAL PRACTICE IS TO ALLOW THE CHANGE TO TAKE PLACE BETWEEN FOREPART AND WAIST AT THE END OF THE SOLE PATTERN AND AT HEEL BREAST IF WELT VARIES FROM WAIST TO SEAT. DETAILS MUST BE GIVEN IF DESIGN DIFFERS FROM ABOVE.

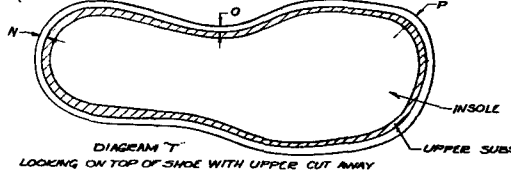
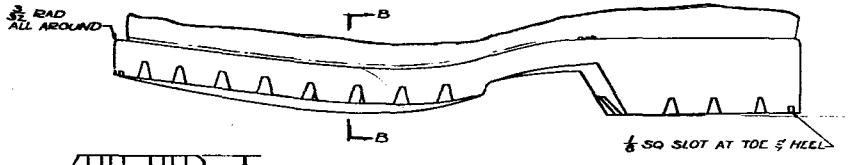
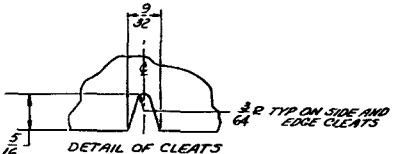
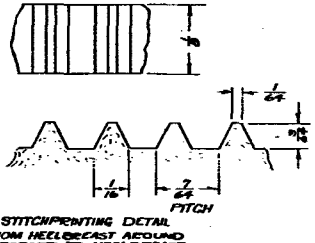



DIAGRAM "T"
LOOKING ON TOP OF SHOE WITH UPPER CUT AWAY

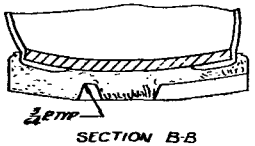


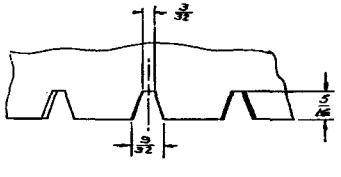

DETAIL OF CLEATS IN FOREPART
SCALE 2"=1"




STITCHPRINTING DETAIL
FROM HEELBREAST AROUND FOREPART TO HEELBREAST
SCALE 10"=1"




SECTION B-B




DETAIL OF CLEATS IN HEEL SECTION
SCALE 2"=1"

FIG.1 DIRECT MOLDED OUTSOLE DESIGN

INSOLES, FOOTWEAR (VENTILATING TYPE) July 1971

1. SCOPE

1.1 Scope.- This specification covers the requirements for polypropylene ventilating type insoles (plastic) for use in direct molded sole leather combat boots.

Schedule of sizes

| Boot Length | Boot Width | | | |
|---|---|---|---|---|
| | R | W | XW | XXW |
| 6 | | X | X | X |
| 7 | X | X | X | X |
| 8 | X | X | X | X |
| 9 | X | X | X | X |
| 10 | X | X | X | X |
| 11 | | X | X | |

2. REQUIREMENTS

2.1 Material.-

2.1.1 Filaments.- The filaments shall be made from virgin polypropylene having the physical characteristics shown in table I.

TABLE I

| | |
|---|---|
| Density ($D^{23c}$ G/ml) | 0.900 to 0.915 |
| Tensile strength | 20,000 psi average |
| Elongation | 15 percent minimum |
| Resistance to water immersion (change in length) | 2 percent maximum |
| Filament diameter | 0.0120 to 0.0150 inch |
| Color | Natural |

2.2 Construction.- Each insole shall be made of three plies of polypropylene screening conforming to filament requirements in 2.1.1 and as follows:

Top ply - Shall be made from monofilament polypropylene of 0.015 inch diameter with not less than 20 ends and 20 picks per inch, woven in a 2 up and 1 down twill weave. The screening shall be calendered. After calendering, the individual monofilament shall have a minimum diameter of 0.012 inch in the narrowest direction and a maximum diameter of 0.026 inch in the widest direction.

Middle ply - Shall be made of 0.015 inch diameter filament, 14 by 14 square woven.

Bottom ply - Shall be made of 0.012 inch diameter filament, 56 by 30 honeycomb mesh. The weave design for the honeycomb mesh shall be as shown in figure 1.

The layers shall be securely joined together around the edge by a method that will weld, fuse, or cement the edges of all the layers into a single unit.

2.3 Thickness.- The thickness of the finished insole shall be not less than 0.110 inch and not more than 0.160 inch.

2.4 Patterns.- Patterns shall conform in size and contour to standard patterns. Variations of plus 1/32 inch or minus 1/16 inch in the length and width of the insoles from the standard pattern length and width shall be permitted.

2.5 Marking.-

2.5.1 Size marking.- The correct size and width of each insole shall be legibly stamped on top side with ink that will adhere to the plastic screening. The size shall be stamped in numbers, and the width in letters. The numbers and letters shall be not less than 1/2 inch and not more than 5/8 inch in height.

2.5.2 Special marking.- The words "THIS SIDE UP - DO NOT BOIL" shall be stamped on the top side of the insole. The letters shall be not less than 1/2 inch nor more than 5/8 inch in height and spaced not less than 1/8 inch and not more than 1/4 inch apart. Spacing between words shall be not less than 1/4 inch and not more than 1/2 inch.

2.6 Workmanship.- The finished insoles shall be evenly woven, clean, free from any fraying, cuts, tears, punctures, decomposition, pulled together or broken filaments, sharp edges, and ply separation.

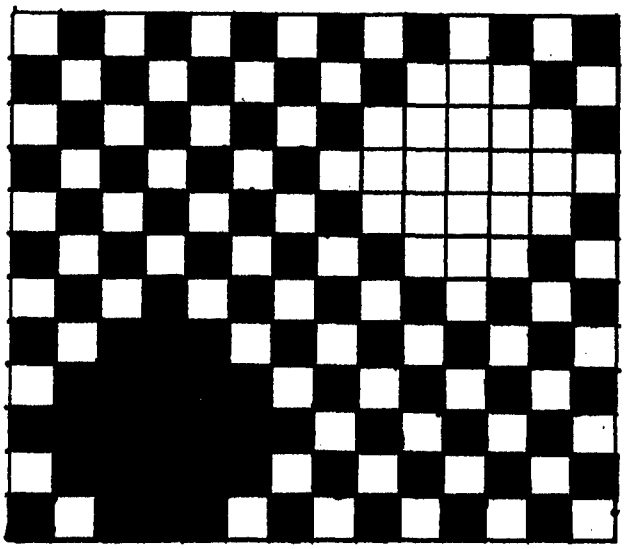


FIGURE 1

HONEYCOMB WEAVE

Repeat 14 ends & 12 picks