

**The fit of the South African National Defence Force male
combat trousers**

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ABSTRACT

This study was contracted by the African Warrior Project of the South African National Defence Force (SANDF), which focuses on the needs of the future soldier. Fit problems cause the wearers of these combat trousers physical discomfort during routine physical training as the trousers restrict movement. The goals of the study were to investigate problems experienced by the male soldiers regarding the fit of the combat trousers, and to make recommendations regarding possible fit solutions. The objectives of this study were to determine the nature of the fit complaints in terms of the wearer characteristics and activities related to aesthetic and functional aspects; to analyse the design of the combat trousers in terms of size, key dimensions, proportion, balance and ease to determine the source of the fit the problems; and to analyse the fit of the combat trousers against the subjective fit preferences of the wearers, and objective fit opinions of an expert. The target population of the study was the male SANDF members in the target age group of the African Warrior Project, namely 18 to 35 years. The first sample group consisted of 60 SANDF members between the ages of 24 to 45 years. The second sample of 24 subjects was selected from the first sample group, using height and body shape as parameters. The methods included biographic profiling, focus group interviews, one-to-one interviews, motor tests, body and garment measuring, photographs, somatographs and pattern analysis. The findings indicate the possibility of an inadequate garment design in relation to specific wearer characteristics such as ethnicity and body shape. The complicated size designation system used, compounded by the waist as the only key dimension provided, contributed to the distribution of the incorrectly sized combat trousers to the wearers. Analysis of the design indicated that it does not adequately accommodate the body characteristics and fit preferences of the subjects, to ensure optimum functionality as well as an acceptable aesthetic appearance. These problems need to be addressed.

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CHAPTER 1: INTRODUCTION AND OVERVIEW

1.1 INTRODUCTION

Male members of the South African National Defence Force (SANDF) have complaints regarding the fit of their combat trousers. Their main concern is that the crotch is too low (that is, the crotch seam is too deep). This problem causes the wearers of these combat trousers physical discomfort during routine physical training and other activities as movement is restricted and it also has a detrimental effect on appearance. Kaiser (1990:4) defines appearance as the total composite image created by the human body and any modifications, embellishments, or covering of the body that are visually perceived; a visual context that includes clothing as well as the body.

Poor fit of clothing is a major problem that affects consumers worldwide (Salusso-Deonier 1989:371; Labat & DeLong 1990:43; Workman 1991:251; Ashdown & DeLong 1995:47; Goldsberry, Shim & Reich 1996:121; Huck, Maganga & Kim 1996:45; Winks 1997:1; Ashdown 1998:324; Kohn & Ashdown 1998:17; Anderson, Brannon, Ulrich, Presley, Woronka, Grasso, Gray & Clarity Fit Technologies 2000:2; Workman & Lentz 2000:252; Kinley 2003:19; Tselepis & de Klerk 2004:84; Connell & Presley 2005:53.).

According to Workman and Lentz (2000:252), fit refers to the way a garment conforms to or differs from the body. Ashdown and DeLong (1995:47) define fit as the relationship between apparel and the body. Common causes of poor fit include inaccurate sizing, insufficient ease of movement and different types of body shapes and sizes (Winks 1997:46; Price & Zamkoff in Workman 1991:31,32,34).

Tate in Tselepis and De Klerk (2004:65) states that the fit of a garment is determined by accurate garment measurements and the amount of movement ease allowed. Consumers are often uninformed and do not know their own measurements and also do not know where to take them accurately (Brown & Rice 1998:131). Sizing systems in South

Africa, as elsewhere in the world, are not standardised for manufacturing. Even knowing one's size will not necessarily solve the problem of finding garments that will fit (Anderson *et al.* 2000:3). Consumers often have to shop around and have to fit several garments before finding a size that will fit them best (Kinley 2003:19). Military uniforms are issued according to a set of standard dress measurements and the soldier does not get the opportunity to try on different garments in different stores to suit his own preferred style and body shape.

In accordance with the specifications set by the South African Bureau of Standards (SABS) in 2003, the waistline and inside leg length measurements are used as key dimensions to indicate what size trousers will be issued to the SANDF members. The waistline and inside leg length measurements alone are not a sufficiently accurate indication of what the rest of the lower torso measurements will be. Body form is not taken into consideration for the size specifications. Hillestad (1980:121) defines body form as the characteristics of size, shape of various body parts, and composition or morphology (proportion of bone/muscle mass/adipose tissue).

According to Salusso-Deonier (1989:371) many consumers worldwide experience fit problems with a garment because their body forms are not identical to that of the fit models used by the manufacturers. Salusso-Deonier (1989:373) has determined that although a set of consumers all have the same body dimensions as a selected sample size, all of these consumers could experience poor fit due to the variety of body posture types and body proportions.

A garment could provide insufficient ease due to the poor alignment of the garment fabric grain relative to the wearer's posture (Salusso-Deonier 1989:373). Huck *et al.* (1996:45) define garment ease as the difference between the size of the garment and the body size of the wearer. It is accepted that soldiers require sufficient ease for movement during routine training and active duty, and that a garment which restricts movement

during normal activity is highly unacceptable. Salusso-Deonier (1989:373) suggests that one solution to this type of problem is to provide a variety of dress forms according to posture, rather than minimising sizing options to designations such as small, medium and large. The applicability of this suggested solution to the fit problems of the SANDF combat trousers remains to be proven.

The review of relevant literature clearly indicates that fit is a major problem facing consumers worldwide, as demonstrated by recent research.

The findings of this study can provide solutions for this problem. Solving this problem can result in better fitting combat trousers that are functionally and aesthetically acceptable to the male population of the SANDF.

1.2 THEORETICAL FRAMEWORK

The research problem is complex because it pertains to the relationship between the body and its dress. Due to the complexity of the problem, Hillestad's Taxonomy (1980:118) was selected as a point of departure to develop a conceptual framework for this study. This taxonomy is presented in Figure 1.

According to Hillestad's Taxonomy (1980:117), dress and body are both important aspects of appearance. Hillestad (1980:117) defines appearance as an aspect of culture that involves the human body and its coverings, as well as embellishments placed upon it. Dress is a form of clothing that can be characterised by its function to comfort and protect the body in compliance with the clothing articles' specified purpose. The body is characterised by the entire physical structure as a unit, especially units that perform specialised functions for example, the lower trunk for leg movement (also known as gait) (Hillestad 1980:123). In the case of this study, the appearance of the uniformed soldier depends on how well the combat trousers conform to his body without causing any physical discomfort.

Hillestad (1980:117) continues to describe the factors of appearance related to dress. Dress is described by Hillestad (1980:117) as the result of assembling various articles about the body. He describes these dress articles in two forms: that of clothing, for example combat trousers (in the instance of this study), and that of adornment, for example jewellery. The sub-units of dress are the materials used, processes used in the development of the fabrics, and techniques used in the production (Hillestad 1980:119).

Looking at Hillestad's Taxonomy (1980:120), the body is illustrated as a counterpart to the structural unit pertaining to dress. The body is defined as a vehicle for dress. The structure of the body, as a contained unit, is the sum of various body parts. Furthermore, Hillestad (1980:120,121) sees the body as the sum of various units of body expressions, namely: form, surface and motion. The way the body expresses itself affects the appearance of the dress. The factors of dress and body, therefore, interrelate to result in the most suited appearance. Hillestad's Taxonomy is presented in Figure 1, overleaf.

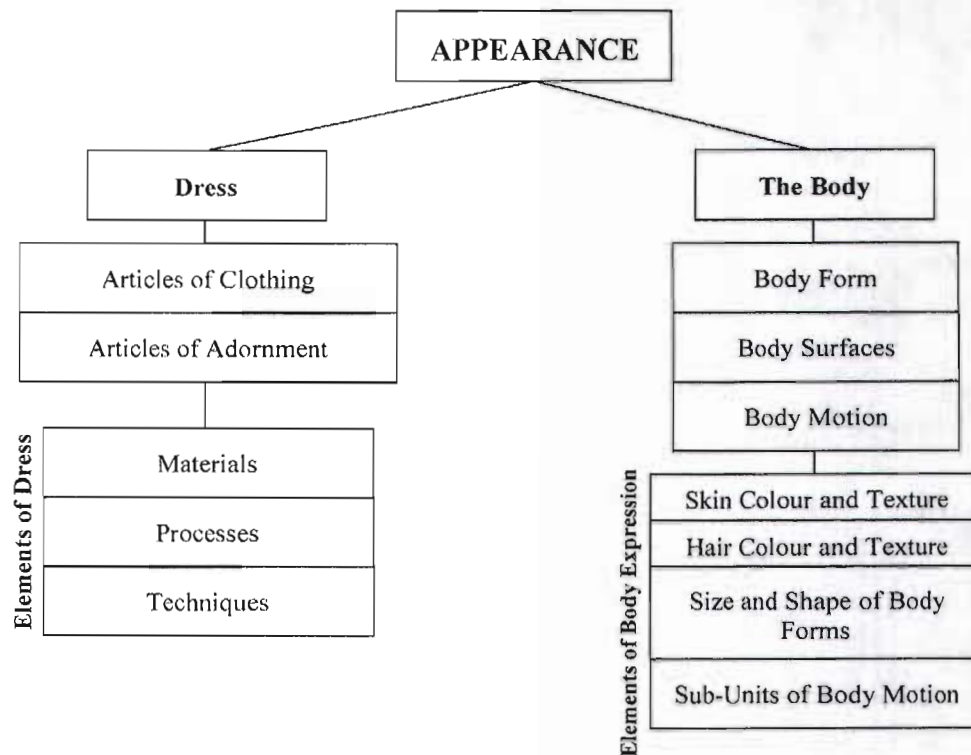


Figure 1: Hillestad's Taxonomy for identifying the various units involved in the structure of appearance (1980:117).

For the purpose of this study, Hillestad's Taxonomy (1980:117) has been adapted to develop a model that is more suitable for the study of functionality and appearance of military wear and its consumers. This model is presented in Figure 2 and serves as the conceptual framework for this study.

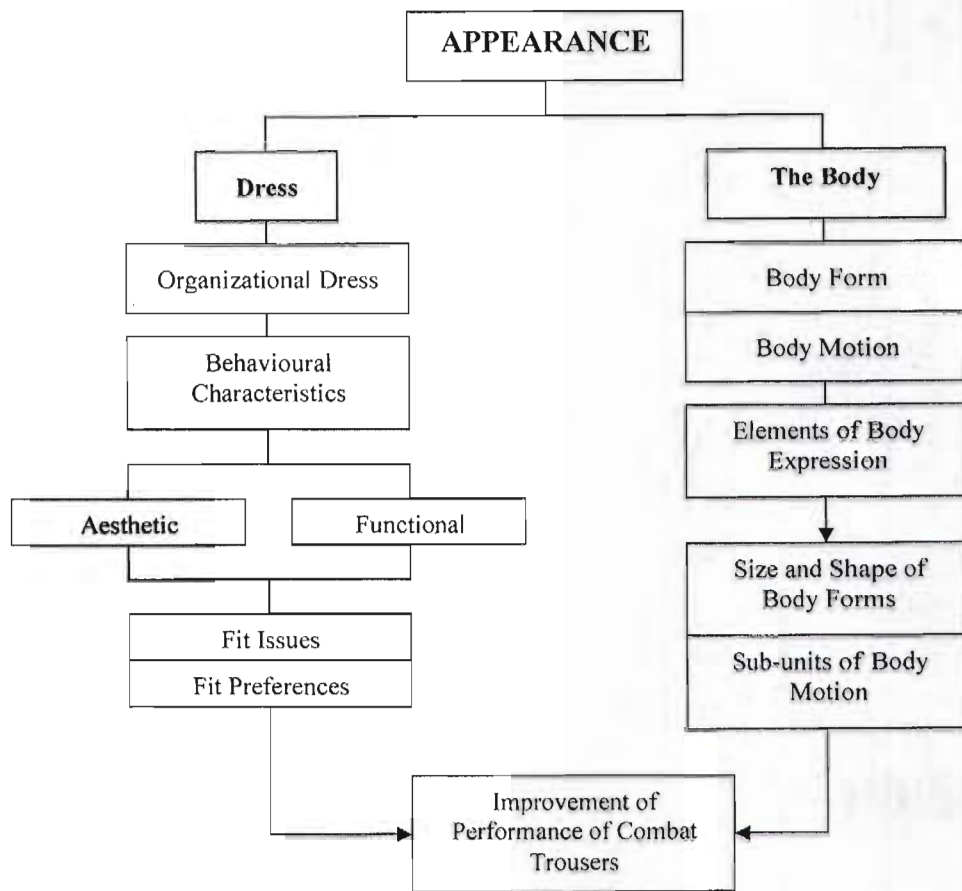


Figure 2: Conceptual model for the appearance of military wear, adapted from Hillestad's Taxonomy for appearance.

In order to present a clear understanding of the conceptual model, all the variables are clearly described. In terms of the adapted model, Hillestad (1980:117) and Kaiser (1990:4) have previously defined appearance in terms of differing viewpoints that are both applicable to this study. Hillestad's (1980:117) approach from a cultural point of view is used to study military uniform in the context of the organisation (military). Kaiser's (1990:4) definition focuses on how the uniform, consumer, and organisational image are visually presented and perceived on the clothed body.

Body motion is a very important factor with regard to this study, as it affects the physical performance of soldiers. Hillestad (1980:121) defines body motion as a variety of states of motion related to the body, also known as 'kinetic behaviour'.

Rudd and Lennon (2001:122) highlight the relationship between body and dress, as dress must allow for body motions such as walking, sitting, gestures, mannerisms, posture, and all body movements. For the purpose of this study, the sub-units of body motion that will be investigated are body posture and body gait (i.e. forward hip stance and leg and trunk movement). The posture and gait motions of the body will affect the way that the issued military dress will fit on the soldier. The performance of the soldier is likely to be poor if the issued garments fit poorly. This can affect the image/identity of the soldier and the organisation to which he belongs.

The relationship between garment fit, performance and image/identity of the soldier brings the focus of the study to the organisational dress of the soldier. Organisational dress serves two key functions: it asserts control and it conveys identity (Joseph 1986:45).

A military force may be classified as a protective organisation, with its primary function to defend the public (Kaiser 1990:374). A well-regimented appearance is expected in protective organisations, in order to portray an image of efficiency and competence (Kaiser 1990:374). A uniform depicts the properties of the organisation in tangible form as the uniform physically represents the organisation (Joseph 1986:42). In a corporate organisation, the uniform serves to assert a feeling of belonging to a distinct group that is different from any other organisational group (Joseph 1986:35).

Behavioural characteristics refer to what can be achieved by the clothing item. In order to provide a uniform that is of quality fit, behavioural characteristics such as functionality and aesthetics are examined (Brown & Rice 1998:38,39). Functional

behavioural characteristics refer to the durability of the clothing products, such as suitability for various purposes and occasions. Additionally, functional traits pertain whether the clothing item will maintain its appearance and structure when being worn and cared for and whether the clothing item fits comfortably (Brown & Rice 1998:38,39).

The functional aspects that will be researched in this study are movement ease, dimensions of the consumer and the garment and the level of physical comfort provided by the garment. The impact of movement ease of the combat trousers on the soldier's performance during physical training is important to consider. Insufficient movement ease can cause physical discomfort and result in the poor appearance and performance of the soldiers. The style of the combat trousers in relation to the soldier's body is a possible cause of physical discomfort.

The style of the combat trousers is an important component of the aesthetic appeal of the uniform. Aesthetic behavioural characteristics refer to the appearance or aesthetic experience of the clothing item. On a sensory level, this refers to whether the fabric bunches up or wrinkles. An emotional aesthetic appeal refers to evoking specific feelings for the wearer. Finally, on a cognitive level aesthetic appeal refers to whether the clothing item has certain symbolic significance for the wearer (Brown & Rice 1998:38,39). For the purpose of this study, style and fashion will be considered as important aesthetic aspects that influence the fit of the trousers.

Behavioural characteristics of clothing directly influence the quality of a garment (Brown & Rice 1998:38,39). A quality garment is one that satisfies the consumer's need for a well fitting garment (Tselepis & de Klerk 2004:87). Various fit issues and fit preferences are explored to determine what the soldier expects from quality combat trousers.

The fit issues that are focussed on in this study are issues that affect the performance of the combat trousers. These issues include size, ease, balance and grain alignment to the posture of the clothing item. The perceptions of clothing experts and soldiers are investigated in order to establish the actual cause of fit problems experienced by the soldiers concerning the combat trousers. Referring back to Figure 2, all the aspects of both the dress and the body are discussed to explore all possibilities that will lead to the performance improvement of the combat trousers.

1.3 GOALS AND OBJECTIVES OF THE STUDY

➤ Goals

1. To investigate problems experienced by male military members of the SANDF with the fit of the trousers, especially in the crotch area.
2. To make recommendations regarding possible solutions for the fit problems of the male combat trousers.

➤ Objectives

Keeping true to Hillestad's Taxonomy (1980:117), the objectives of the study are focused on the male body (the soldier) and the dress (combat trousers). With good fit, aesthetics, functionality and corporate image in mind, more specifically the following objectives are set for the study:

1. To determine the nature of fit complaints by the soldiers and to interpret it in terms of wearer characteristics and activities related to aesthetic and functional aspects.
2. To analyse the design of the combat trousers in terms of size, key dimensions, proportion, balance and ease to determine the source of the fit problems.
3. To analyse the fit of the combat trousers, and interpret the findings against the subjective fit preferences of the wearers, and objective fit opinions of the experts.

1.4 EXPECTED OUTCOMES

The following outcomes are expected as a result of the completion of this study:

- Investigation of the body posture and proportions of the wearers may provide solutions for achieving better fit of the combat trousers.
- The size and key dimensions of the issued garments used may be identified as factors that influence the fit of the combat trousers.
- The design of the pattern may be identified as a cause of the problem associated with the fit of the combat trousers.
- The wearers' fit preferences could be shown to influence their perception of the fit of the combat trousers.

Following this introductory chapter, the remainder of the research report is presented in the following order. A review of relevant literature to the research problem is presented in Chapter 2. An overview of the research design is presented in Chapter 3, followed by a presentation of the findings and discussions in Chapter 4. The research study is concluded in Chapter 5. The closing chapter provides a synopsis of the completed study and an overview of the findings. The findings are related back to the research objectives and recommendations are made with a view to providing solutions to the problems associated with the fit of the SANDF male combat trousers.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

The conceptual model for the appearance of military wear, developed from Hillestad's Taxonomy (1980:117) is used to structure the order of the literature review.

2.2 THE BODY

Hillestad (1980:121) describes the body as the sum of various units of expression. As a structural unit, the body consists of three expressions: body form, body surface and body motion (Hillestad 1980:121). Body surface does not apply to this study because it is concerned with detailed surface features of the body such the eyes and hair.

Posture and gait are aspects of body motion that are discussed in this study. Hillestad (1980:121) refers to posture as the body in a motionless state; however, this state is interrupted by various types of motion such as gait. The term gait refers to the movement of the legs and trunk.

Hillestad (1980:123) describes body form as the size and shape of various body parts as well as the frame of the body (bone size, muscle structure and adipose tissue). Body form is mainly the result of genetics and is also influenced by diet and exercise (Horn & Gurel 1981:143). Numerous intra-racial and inter-racial differences in body types can therefore be expected.

2.2.1 Body types

Criteria for the ideal body form were established in Ancient Greece (Fan, Yu & Hunter 2004:4). The Greeks developed criteria for determining, what was to them, an ideal body (Fan *et al.* 2004:4). The various body dimensions were divided into units of head measurements. Although the Greek standard is widely accepted as the ideal body form, society's perception of beauty within a specific culture can vary over time. During the

fifteenth century, for example, a plump, large-breasted female was considered to be attractive (Fan *et al.* 2004:4).

To make sense of the variations of body forms that exist worldwide, various scientists have tried to classify body types into categories. One of the earlier classifications of body types (somatotypes) is that of Sheldon (1954:58,59). According to Sheldon (1954:58,59), the human body can be categorised into three basic somatotypes according to similarities. These somatotypes are the endomorph, the ectomorph and the mesomorph. The endomorph refers to a rounded body with soft body tissue. The ectomorph refers to a tall, slim body with stringy muscles, and the mesomorph represents the athletic body with a well-built muscular physique. The balanced body is a combination of these extremes (Sheldon 1954:59).

According to Kefgen and Touchie-Specht (1981:185) and Johnson (1990:35), very few people can be categorised according to only one of these body types. Johnson (1990:35) suggests that two or more body types should be used for categorisation. These are the ecto-mesomorph and the endo-mesomorph types which combine different characteristics of two different body types. The integration of people across the globe has resulted in subsequent generations revealing a mixture of body types that vary in shape and size (Kefgen & Touchie-Specht 1981:185).

Rasband (1994:12) suggests that body types should be categorised according to body shape. The body is shaped by contours which refer to the curves of the body. The curves of an individual will vary according to his body form. Rasband (1994:12-13) categorises body types according to geometric shapes namely the triangular, inverted triangle, rectangular, diamond-shaped, tubular and rounded.

Vogue (1975:416) provides the following examples of well-known male body characteristics:

- A baywindow, which is formed by excess flesh through the midriff area.
- Bulging hips, which are formed by fleshy pads sitting on the side of the hips.
- Forward hip stance, that causes the abdomen and hip to be thrown forward causing a swayback.
- Backward hip stance, that causes the hips to be thrown higher and toward the back.

Apparel manufacturers frequently classify body types according to the body size and its measurements, for the purpose of pattern development (Cooklin 1997:4; McCulloch, Paal & Ashdown 1998:492).

The question therefore arises regarding what criteria are used by apparel manufacturers to establish a standard body according to which standardised patterns may be developed. To this day, apparel manufacturers make use of previously mentioned Greek criteria, to describe a standard body (Liechty, Pottberg & Rasband 1992:34).

The observation of individual bodies clearly indicates that almost nobody has an ideal body (Kinley 2003:19). It is preferable that the accepted standards for the ideal body are rather to be used as a measure of comparison to determine differences. Rasband (1994:6) emphasises that an individual's body differences from the ideal body should not be perceived as body flaws, faults or deformities but rather as body variances. The concept of an ideal body changes from culture to culture and according to changes in fashion (Kefgen & Touchie-Specht 1981:198; DeLong 1998:107).

It is presently accepted that the ideal male body type is prototyped after the youthful athlete (Kefgen & Touchie-Specht 1981:200; McDonald 2002:1). The overall image of the ideal male body is tall and slender with broad, well-developed shoulder muscles.

The torso tapers to a slender waist, the abdomen is flat, the hips are narrower than the width of the shoulders and the arms and legs are slender and muscular. The head, hands and feet are in proportion to the rest of the body (Kefgen & Touchie-Specht 1981:200).

Regardless of whether an individual's body is considered ideal according to the society norms, it still needs to be accommodated with comfortable garments that fit the body. Although every culture has an ideal body type for males and females, individuals have unique characteristics that influence the form of their body.

2.2.2 Physical characteristics of the wearer

The physical characteristics of the wearer can vary in a myriad of manners such as age, gender, body contours, posture, bone size, body weight, body height, body proportions, ethnicity and general lifestyle (environment, nutrition, and activities) (Roach & Eicher 1973:38; Horn & Gurel 1981:143; Kefgen & Touchie-Specht 1981:200; Johnson 1990:35; Yavatkar 1993:411; Rasband 1994:6; Goldsberry *et al.* 1996:121; Pechoux & Ghosh 2002:2-10). The physical characteristics of the wearer are defined as interrelating factors that influence one another in order to determine body variations among individuals (Rasband 1994:6).

2.2.2.1 Age

The human body changes with age in terms of shape and height, causing the proportions of the body to change (Goldsberry *et al.* 1996:121; Pechoux & Ghosh 2002:3). Changes in girth (width) are more common than changes in vertical measurements (Patterson & Warden, Bader in Goldsberry *et al.* 1996:122). Various authors concur that the most predictable body changes with age include the expansion of the waist and abdominal girth combined with the shortening and curvature of the spinal column. In other words the body decreases in height with age (Hoffman, Patterson & Warden, Smather & Horridge in Goldsberry *et al.* 1996:121; Pechoux & Ghosh 2002:3).

Common spinal deformations that occur in the body include scoliosis (sideways deformality), lordosis (swayback), and kyphosis (hump back) (Pechoux & Ghosh 2002:3).

An increase of fat around the body is another common change that occurs with age (Pechoux & Ghosh 2002:3). Body fat distribution varies among individuals (Vella & Kravitz 2002:3). Increased body fat is often carried in and around the abdominal area. This type of fat deposition is referred to as the android or apple body type and is most common among males (Vella & Kravitz 2002:3).

2.2.2.2 Gender

Anthropometric studies reveal that there are distinct differences between male and female bodies among various ethnic groups (Yavatkar 1993:411). Physical characteristics such as height, weight and fat distribution vary among the male and female genders.

Very few people have what is described as an ideal body type. In addition, global integration has resulted in few male and female bodies that can be categorised as being fully male or female. A male body that, for example, is narrow in the shoulders, tends towards classification in terms of female characteristics (Yavatkar 1993:411). Subsequently, these differences are discussed in terms of the body contours, posture, bone size, body weight and body proportion.

2.2.2.3 Body contours

Body contours refer to the curves of the body (Rasband 1994:12). The body frame, proportions, weight, muscle tone and posture determine the size and location of these curves. The contours of the body change with age. Contours are not mainly formed by soft body tissue, muscle and fat as commonly believed. The size and shape of the bones underneath play a far more important role in determining body contours (Rasband

1994:12).

The weight of the individual will determine the extent to which the curves will fill out. Although diet and exercise affect weight, exercise also firms up the contours. Posture aligns the body and therefore influences the contours of the body. In addition, the contours of the body sag with age as a result of gravity (Rasband 1994:12).

2.2.2.4 Posture

Posture, also termed as stance, refers to the alignment of the body parts and to the manner in which the body frame is carried (Liechty *et al.* 1992:37). The standard body is conceptualised as having an imaginary, straight, perpendicular line that bisects the ear, neck, shoulder joint and elbow, passes just to the back of the wrist, bisects the hip joint and knee, and finally passes in front of the ankle.

Seven posture types are identified by Liechty *et al.* (1992:37) namely: correct, protruding abdomen, overly erect back, rounded upper back and shoulder with forward head, swayed back/forward pelvic tilt, slumped posture with rounded shoulders, backward pelvic tilt with forward head. The posture of an individual subject can be identified by comparing a side-view photograph of the subject to the illustrated posture depicted in Liechty *et al.* (1992:37).

Correct posture is vital to maintain good health by walking, sitting and standing correctly. When good posture is not maintained, the body weight becomes unevenly distributed with age, placing strain on the muscles, bones and joints, resulting in health problems (Kefgen & Touchie-Specht 1981:193)

2.2.2.5 Bone size

Bone size, also termed as bone structure or body frame, refers to the relative size of an individual's bones, measured at the wrist, elbow or ankle (Rasband 1994:7). These body

areas seldom carry extra weight in comparison to areas such as the shoulders, hips and abdomen. Bone size is directly related to bone weight. The larger the size of the bones, the greater the weight of the bones and the greater the weight that can be carried on the bones.

2.2.2.6 Body weight

Body weight is a determinant of the body type. The ideal weight is largely influenced by cultural ideals that range from skinny to obese.

Ideal weight can however also be determined by health standards. This is done by comparing the height of an individual to his/her body frame. A male with, for example, a medium body frame and a height of 175cm should weigh between 67,50kg and 74,25kg (Kefgen & Touchie-Specht 1981:207). Being either too much over or too little under this calculated weight range can pose health risks (Rasband 1994:8). Maintaining a healthy diet and exercise regime can help an individual to achieve a healthy, ideal body weight and slow down the process of aging (Kefgen & Touchie-Specht 1981:188, Rasband 1994:8).

An anthropometric survey performed by the Chamber of Mines of South Africa Research Organisation (CMSARO), clearly indicated that Africans who live and work in urban areas have a higher mean weight compared to Africans that live in rural areas (Wyndham in Chapanis 1972:121). The study was conducted on two Bantu tribes in South Africa. One group consisted of Pedi males in Sekukuniland, the other Venda men in Vendaland, with a mean age of 32 years. The results from the two tribes were almost identical to the mean weight for rural areas being 56,2kg and for urban areas 60,6kg. Wyndham (in Chapanis 1972:121) ascribed this difference in weight to the prevalence of deficiency in animal protein and marginal calorie intake of the rural Bantu tribes.

2.2.2.7 Body height

Body height, in particular, is a characteristic that differs among males from different races. On average, variances in height among males may differ from 150cm to 180cm. The CMSARO's study indicated that South African Blacks are, in general, significantly smaller than males of European origin (Wyndham in Chapanis 1972:116).

2.2.2.8 Body proportions

Cultural influences and changes in fashion also determine perception of ideal body proportions. The Greek notion of ideal body proportions is a good indicator of cultural influence.

Proportion refers to the relationship between individual body parts and their relationship to the body's total height and mass (Rasband 1994:9). Individuals vary in proportion to one another in terms of size, length, width and weight.

Proportional body areas can be determined by break points on the body where the silhouette changes in direction, for example, an inward angle at the narrowest point such as the waist and an outward angle at the widest part of the body such as the hips. These areas can be compared to each other, to other sections of the body or to the total height of the individual. The comparison can be analysed against the apparent ideal proportions of the human body.

An example of the differences in body proportion of South African Blacks in comparison to South African Whites was indicated by the findings of the anthropometric study conducted by the CMSARO (Wyndham in Chapanis 1972:118). The findings of the CMSARO study are presented in terms of dimensions that are useful when considering the design of the SANDF combat trousers.

TABLE 1: COMPARISON OF MEASUREMENTS OF WHITE AND BLACK SOUTH AFRICAN MINE WORKERS

Dimensions	White South African military recruits (mm)	Black South African mine workers (mm)
Crotch height	846,6	818,1
Sitting height	917,7	860,1
Popliteal height	431,1	416,8
Buttock-leg length	1 073,6	1 013,5
Hip breadth	342,3	300,3
Waist circumference	752,5	749,3
Buttock circumference	925,7	860,5
Thigh circumference	521,7	496,1
Calf circumference	395,8	340,9

Based on the dimensions presented above, Winks (1997:12) has inferred that the ratio of sitting height to total height of Black males is significantly lower than the ratio for White males in South Africa. According to Winks (1997:12), this is an indication that the legs of Blacks are proportionately longer. This supports the findings of Tildesley, cited in Winks (1997:12) that the longitudinal limb measurements of people living in warmer climates tend to be greater in proportion to overall height.

2.2.2.9 Ethnicity

Prehistoric humans occupied various parts of the globe at different times and were subsequently compelled to adjust to different climatic and other environmental conditions. As a result, Homo sapiens developed into distinct racial groups (Johnson 1990:1). There are no longer any pure race groups left due to global integration (Pechoux & Ghosh 2002:10). People can be categorised according to four basic race groups, namely Australoids, Caucasoids, Mongoloids and Negroids. These racial groups are more commonly known as Asian, Caucasian, Mongolese, and African. There are distinct physical differences that can be observed between the race groups.

Giddings and Boles (1990:25-28) conducted a study on the comparison of the anthropometry of Black males and White males with regard to implications for the fit of pants. The study by Giddings and Boles (1990:25-28) considered anthropometric

morphology and the difference in the difficulty of obtaining pants that fit properly. It was found that Black males experience more difficulty in obtaining proper pants fit in the thigh area than their White counterparts. It was further revealed that in general, Black males had a smaller waist, larger medial thigh and a higher buttock curve height than the White males who participated in the study. Giddings and Boles (1990:25-28) therefore suggested that in order for a Black male to obtain a good fit, a larger size pants should be purchased to fit the thigh and the waist should be altered to accommodate a smaller size. The findings of this study clearly indicate that ethnicity should be taken into account when considering the fit of a garment.

In conclusion, Giddings and Boles (1990:28) suggest that manufacturers should seriously consider the effects of racial differences in body proportions and anthropometrics upon the fit of pants for men. Further research is required to investigate the possible provision of apparel products that target specific race-related markets.

2.2.2.10 Lifestyle

Lifestyle comprises three basic variables namely, environment, nutrition and activities. Environmental influences on the physical characteristics of the body are considered by Fan *et al.* (2004:9) to be of social and cultural origin. A social environment establishes norms that determine what is culturally acceptable for that society in terms of numerous behavioural and physical aspects, including the ideal body form. Present-day societies in the 21st century generally promote the popularity of sport, improvement of nutrition, hygiene and higher living standards.

The second variable that determines lifestyle is nutrition, which refers to the amount and type of food available for consumption. Nutrition may account for differences in body development and subsequently influence body types (Roach & Eicher 1973:40). Individuals require the same nutrients in different amounts, according to their age, sex, activities, size and state of health. An inadequate supply of nutrition to the body will

cause the body to change its physical appearance in terms of height, weight, muscle form, bone strength and general health. Obesity is however no different, causing health problems, in particular due to the excess body weight that places strain on the body organs (Roach & Eicher 1973:41). Physical exercise is necessary to combat excess weight.

Puone, Steyn, Bradshaw, Laubscher, Fourie, Lambert and Mbananga (2002:1038,1048), found that an increasing number of Black South Africans are becoming overweight or obese due to over-nutrition as well as the perception of South Africans regarding the positive values ascribed to obesity.

A study conducted regarding the national food consumption in South Africa, revealed that South Africa is considered to be one of the countries in sub-Saharan Africa that is undergoing rapid demographic and nutritional transition (Steyn, Labadarios, Maunder, Lombard & Directors of the National Food Consumption Survey 2005:4). Those dietary and lifestyle changes have been associated with an increase in overweight and obesity in the adult population (Steyn *et al.* 2005:5).

The level of fitness required from exercise depends on the individual's organisational activities (Kefgen & Touchie-Specht 1981:193) such as working at a desk or practising combat training. In order to perform daily activities, the clothing that is worn must be adequately suited to the size and shape of the individual's body, so that it can be worn without constriction of movement. Body motion is subsequently discussed in terms of mobility in clothing.

2.2.3 Body motion

Hillestad (1980:123) describes body motion as either a one-unit system within which the trunk of the body operates as a solid unit, or as a two-unit system where the body moves separately in the lower and upper trunk. An example of lower trunk movement is gait,

i.e. the movement of the legs and trunk.

The physical characteristics of the human body affect the way an individual moves because the positions of the neighbouring body parts may alter a particular movement (Watkins 1984:145). Ease of body movement in clothing is related to comfort and function (Watkins 1984:144). An individual is generally more comfortable if he/she can move in a garment without straining the item. If the individual does not need to work against the garment, he/she can perform more effectively (Watkins 1984:144).

2.2.3.1 Analysis of body motion for clothing fit

Winks (1997:165) describes various methods to analyse body motion for the purpose of garment design. There are however two main methods commonly used: the analysis of body elongation and contraction, and wrinkle analysis of clothing.

The first method, namely the elongation and contraction of a specific body area, is related to the elongation and contraction of the clothing item that covers it. When the knee, for example, is bent the leg area expands in length over the kneecap and decreases behind it. If a pair of tight, non-stretch pants are worn, it will therefore be difficult to bend at the knee. The ability to move is reduced by the insufficient fabric length over the knee cap and the bunching of fabric behind it.

The second method involves the analysis of wrinkles to indicate areas where more garment ease is needed for a particular movement to be executed with comfort. The line of pull created, as wrinkles form due to a certain body motion, is observed to determine areas where fit problems occur.

It follows that in order to design an item of clothing or analyse garment fit, the elements of body expression need to be clearly understood. The following section focuses on understanding the elements of dress, which are subsequently interpreted in terms of the

body.

2.3 DRESS

The focus of this study is on uniforms as a form of organisational dress. Kaiser (1990:361) describes organisational dress as a special form of dress.

There is often confusion between the terms 'uniform', 'uniformity' and 'military dress' (Joseph 1986:114). Military clothing could simply be a form of working clothes or tough clothing for a physically demanding job (Joseph 1986:114). Military clothing can also be referred to as a form of standardised clothing. Uniformity refers to the sameness of something. "Uniformity, as distinguished from a uniform, may arise through a variety of circumstances, serve many functions, have a wide array of connotations, and not necessarily denote membership in a formal organisation" (Joseph 1986:115). The uniform is the artificial construct in which uniformity is one of its characteristics (Joseph 1986:115). Uniformity is seen in clothing of groups such as the military and the police.

The qualities that characterise an organisation will be considered, therefore, organisational dress will be discussed in greater detail.

2.3.1 Organisational dress

Berelson and Steiner (in Kaiser 1990:361) identify four qualities of an organisation. First, a sense of formality exists that promotes the collective goals, policies, or procedures and rules that apply to structure the organisation. Second, a hierarchical structure exists among employees that is maintained so that individuals in power may sustain their influence. Third, organisations are made up of relatively large numbers of people, to the point that close interaction with all members is impossible. Fourth, organisations tend to exist longer than a lifetime (Berelson & Steiner in Kaiser 1990:361). Defence forces are typical organisations, characterised by their uniforms.

Uniforms have different meanings to different organisations (Rafaeli & Pratt 1993:34). The following definitions of uniforms are applicable:

- “The distinctive clothes worn by the members of a group. Soldiers, policemen, and nurses wear uniforms to be easily recognised” (UNIFORMS 1990:1283).
- “An indicator of processes within an organisation and of the external cultural and institutional influences that an organisation sustains” (Rafaeli & Pratt 1993:34).
- “A means of expressing organisational values through conformity to a formal or informal dress code” (Kaiser 1990:361).

In accordance with the conceptual framework of this study, organisational dress is discussed with specific regard to functional and aesthetic behavioural characteristics.

2.3.2 Organisational dress: functional behavioural characteristics

Various authors, cited in Pratt and Rafaeli (1997:865), agree that uniforms have two main functions namely to control and to convey identity. These two functions are subsequently discussed.

2.3.2.1 Organisational function: control

Dress in an organisation is a common form of control, particularly in organisations that provide uniforms (Joseph 1986:65). Control is asserted in a variety of manners. Uniforms enable an organisation to develop ranks among members to which admission becomes a persuasive goal. Additionally, uniforms provide an image to the external public, thereby enforcing organisational codes through the viewer's expectations (Joseph 1986:65). The very existence of uniforms gives an organisation a form of control by denying non-members the privilege of wearing the uniform (Joseph 1986:69).

To understand how a uniform functions as a means of control, the characteristics of the uniform are explored in terms of its influence on the organisation, the wearer and the viewer. This impact is described according to the following four categories: the uniform as a group emblem, the uniform reveals and conceals status position, the uniform

suppresses individuality and the uniform is a certificate of legitimacy (Joseph 1986:66-68).

2.3.2.2 Organisation

Organisations employ uniforms to display membership and commitment to the affiliated group (Joseph 1986:65). Therefore, the characteristics of uniforms discussed with regard to the organisation are 'uniform as a group emblem' and 'uniform reveals and conceals status position'.

- **Uniform as a group emblem**

The characteristics of the uniform define the group, for example, the khaki colour can signify a military unit. The organisation controls its members through the appearance of its uniforms to represent the organisation in visual form. Due to the group's association with the uniform and therefore the organisation, all members of the organisation need to comply with the attributes of the group. The uniform represents these attributes and serves as a totemic emblem of the organisation (Joseph 1986:66). The appearance of a uniformed wearer must therefore be properly represented to the public eye.

- **The uniform reveals and conceals status position**

"The uniform is read as the indicator of a single status, that of membership in an organisation (Hughes in Joseph 1986:66)". By wearing a uniform, the wearer's position/status is made more obvious among members and non-members to avoid confusion. Any other statuses that conflict with the image of the organisation are suppressed. Domestication, by holding a parcel such as a shopping bag, for example, is not allowed.

2.3.2.3 Wearer

The wearer in the organisation can be viewed from two perspectives: firstly as an individual wearer of uniform with his/her own identity and secondly as a group member that is part of an organisation. Wearers of uniforms may feel that their individuality in dress is constrained because of the strict dress codes set by the organisation (Roach & Eicher 1973:127). Belonging to a group does however provide its members with a powerful social status and organisational status (Kaiser 1990:362,363). Through the organisational group, the members are taught discipline, group values and bravery, which are rewarded with certain privileges, duties and rankings (Kaiser 1990:362).

Therefore, the characteristics of uniforms discussed with regard to the wearer, are 'uniform suppresses individuality' and 'uniform is a certificate of legitimacy'.

- **The uniform suppresses individuality**

The uniformed individual is expected to follow the organisational ideology. This means that the organisation controls certain aspects in terms of its members, such as behaviour, appearance and physical attributes (Joseph 1986:68). Individuality falls away as the organisation has the legitimate right to enforce these aspects (Kaiser 1990:377).

- **The uniform is a certificate of legitimacy**

When in uniform, the wearer is expected to be a loyal representative of the organisation and its values, thereby the organisation assumes responsibility for the actions of the wearer (Joseph 1986:85). The uniform is a symbolic oath declaring full allegiance to the group. In order for the uniform to be a valid certificate of legitimacy of its representatives, the public viewer must accept it to be an indicator of special status (Joseph 1986:67).

2.3.2.4 Viewer

Any person who recognises the uniform to any extent becomes a viewer and will have some expectations of how the uniformed wearer should behave (Joseph 1986:73). Even though viewers may recognise a uniform, this does not mean that he/she has the correct knowledge regarding the duties and behaviours of the associated status. With commonly known uniforms such as those of the police or army, only one set of norms is used to evaluate the uniformed wearer; which is to serve and protect the community (Joseph 1986:73).

The viewer does not control the organisation or the wearer. However, the viewer can identify the uniformed wearer and can make an association between the wearer and the particular organisation (Rafaeli & Pratt 1993:35). Therefore, identification as a function of uniforms through its appearance is discussed next.

2.3.2.5 Organisational function: identification

Uniforms are not only a symbol of membership to a particular society. Uniforms were originally used to visibly distinguish between group members and the enemy on the battlefields during warfare (Joseph 1986:10). Uniforms allow the outsider to identify individuals as members of an organisation, and also allow insiders to interpret rank, duties and privileges (Kaiser 1990:362). The identification role of a uniform therefore plays an important part in communication through appearance (Kaiser 1990:364).

- **Physical attributes**

The physical attributes of uniforms result in learned associations to identify an organisation (Bower & Hillgard, Fisker & Yaylor, Rosch & Loyd in Rafaeli & Pratt 1993:37). These physical attributes include colour, material and style of dress, for example, the brown colour of military uniforms conveys trust.

The style of dress can influence organisational attributes such as status and power (Rafaeli & Pratt 1993:36). In the instance of military uniforms, the level of rank is displayed by badges on the right breastplates of the shirts. The fabric colour and style, for example cameo, is an identification of its association with a specific organisation such as SANDF.

- **Homogeneity**

A comparison of the attributes of dress allows a specific type of homogeneity to be categorised within an organisation (Rafaeli & Pratt 1993:37). This refers to the variance of dress that is observed and compared among employees within the same organisation. Colour, fabric and style are compared to heterogeneity, stratified homogeneity or complete homogeneity as categories of dress. Military wear is an example of a complete homogeneity of dress, meaning that all members are dressed in a similar manner (Rafaeli & Pratt 1993:37).

Because an army's uniform is completely homogeneous, it has a high level of conspicuousness. Conspicuousness refers to the level to which organisational dress members are distinctly identifiable from non-members. This refers to the uniqueness of the dress pattern regarding the physical attributes of the uniform. The members of a highly conspicuous organisation are clearly recognisable and distinguishable from non-members. Organisations involved in defence are usually completely homogenous in order to be easily recognisable (Rafaeli & Pratt 1993:37).

The image of a soldier is stereotyped according to the occupation associated with his uniform (Rafaeli & Pratt 1993:106). The wearer may feel more handsome when wearing his uniform in public as 'a man in uniform' is perceived by many to be strong, courageous and attractive (Rafaeli & Pratt 1993:106). The wearer will then clearly feel awkward if his uniform appears to fit him poorly.

From the above discussion, it is clear that a uniform has various attributes that influence the appeal to both viewer and wearer. These attributes are further explored in the following section according to aesthetic behavioural characteristics.

2.3.3 Organisational dress: aesthetic behavioural characteristics

In order to analyse the appearance of the uniform, aesthetics are discussed in terms of the aesthetic response to uniforms. Aesthetics means that the viewer or wearer connects with what he/she is seeing, and assesses the colour, texture, shape and how these are combined (DeLong 1998:2). Aesthetics is therefore the evaluation of what is being viewed (DeLong 1998:2).

Fiore, Moreno and Kimle (in Rudd & Lennon 2001:123) define aesthetics as “The study of human response to the non-instrumental quality of the object or event. In particular, aesthetics address the activated internal processes, the object’s or event’s multi-sensory characteristics, and the psychological socio-cultural factors affecting the response of the creator or appreciator to the object or event.” From this definition, it is clear that the aesthetic experience is created by the senses and that the response to it is affected by cultural and social influences.

DeLong (1998:341) differentiates between culture and fashion in the following statement: “Fashion is a cultural phenomenon whereby ‘new’ is perceived as favourable; appearing up-to-date”. For this study, fashion is explored in terms of aesthetic responses and the main influences affecting the aesthetic response.

2.3.3.1 Fashion

According to Solomon (1985:22), there are many different viewpoints on what is included in the concept fashion.

A perusal of the variations in the definitions of fashion, clearly indicates that the style of the clothing is what is or becomes accepted fashion at a given time (Kefgen & Touchie-Specht 1981:130). In order to understand what style is presently or will in future be fashionable, it is necessary to explore the factors that influence fashion.

2.3.3.2 Fashion influences

Fashion is mainly influenced by three factors: social norms, self-expression and technology (Lurie 1981 in Solomon 1985:4).

- **Social norms**

Younger people use clothing styles as a norm to determine dress codes and the acceptable fit of clothes within a particular fashion (Sproles & Burnes 1994:149). Similar to uniforms, the latest fashions determine the clothing of various affiliated groups such as hippies, bikers and sports-fanatics. The perceptions of different social groups regarding how garments should fit are developed by the current fashions (Stamper, Sharp & Donnell 1991:295). An example of the influence of fashion on the fit of clothing is the degree of ease allowed for freedom of movement. Cargo pants provide a large amount of movement ease.

- **Self-expression**

According to Edwards (1997:39), young men in particular want clothing to enhance their masculinity. The same author states that ever since the 1980's young males have attached great importance to the masculine image as an expression of their social status amongst peers and colleagues. The modern masculine appearance is expressed in terms of two main images (Edwards 1997:40,41). The corporate power look refers to formal work clothes (particularly the suit), which are used to cover, yet emphasise the masculine physical shape. The second masculine image is the outdoor casual look, referred to as the 'masculine outdoors hunk' who wears a white t-shirt and denims with a leather jacket (Edwards 1997:40,41). The masculine image a young man aims to

achieve is pursued for social acceptance (Edwards 1997:41).

- **Technology**

Technology provides the consumer with a wider variety of alternative forms of dress and complexities in aesthetic patterns establishing the 'right' identity (Roach-Higgins & Eicher 1992:24). Recently, the importance of colour for military uniforms has been emphasized by the changes in the look of the combat uniform worn by the U.S. Army. The colour has been changed from the regular khaki blend of colours to hues of grey. This is intended to achieve the effect of white noise, disturbing the focus of the enemy (Vanderbilt 2004:1).

- **Aesthetic response**

Aesthetic response is defined as an individual's involvement in observation and the result experienced. Aesthetic response is concerned with what one selects as an expression of preference. Aesthetic response involves knowing about the form, viewer and the physical and cultural context (DeLong 1998:5).

The viewer is the observer of form (DeLong 1998:16) The viewer can either be the wearer of a garment looking in the mirror, or the viewer of another context such as a stranger, a friend or even a photograph being viewed (DeLong 1998:16). A viewer evaluates a garment according to personal, individual traits and experience, as well as traits shared by social and cultural background (DeLong 1998:16).

According to Yoo (2003:50), not only are aesthetic attributes of dress (elements and principles of design) vital in the study of consumer aesthetic response, but also the wearer's characteristics. Various authors cited in Yoo (2003:52) state that age, gender, ethnicity, geographic location, occupation and body types are wearer characteristics that affect aesthetic response.

DeLong (1998:16) adds that personality, physical stature, maturity and aptitude affect the viewer's perception of aesthetics. Individuals in the same age group may share similar aesthetic responses because of sharing certain experiences together (DeLong 1998:16). The combination of knowledge, experience, sensory perceptions, and expression of likes and dislikes, informs the development of individual apparel preferences (DeLong 1998:16). These preferences determine the priority of clothing characteristics used by a wearer to select garment design. Whether the consumer prefers an exquisite look to physical comfort, will play a role in garment selection (DeLong 1998:18).

Another factor that is closely related to the wearer's perception of the quality of a garment is its fit.

2.4 FIT

There are various definitions of fit. Fit can furthermore be defined in terms of poor and good fit. These terms are defined below:

- "Fit is directly related to the anatomy of the human body and most fit problems are created by bulges of the body" (Cain in Fan *et al.* 2004:31).
- "Clothing that fits well, conforms to the human body and has adequate ease of movement, has no wrinkles and has been cut and manipulated in such a way, that it appears to be part of the wearer" (Chamber & Wiley in Fan *et al.* 2004:31).
- "Fit is defined as a combination of five factors: ease, line, grain, balance and set" (Erwin & Kinchen in Fan *et al.* 2004:31).
- "Clothing fit is a complex property which is affected by fashion, style and many other factors" (Efrat in Fan *et al.* 2004:31).
- "Clothing should fit the body smoothly with enough room to move easily and be free from wrinkles" (Hackler in Fan *et al.* 2004:31).
- "Clothing which fits, provides a neat and smooth appearance and will allow maximum comfort and mobility for the wearer" (Shen & Huck in Fan *et al.*

2004:31).

- “[Fit is defined as] the ability to be the right shape and size” (*The Oxford Dictionary* in Fan *et al.* 2004:31).
- “Good fit can be defined as the individual preference of fit” (Anderson *et al.* 2000:1).
- “Good fit is comfort in wear, with sufficient room to allow easy movement, no unnecessary wrinkles and bunching of the fabric or a display of bagginess, and that it should be aesthetically acceptable as well as fashionable” (Tate in Tselepis & De Klerk 2004:88).
- “Poor fit implies that a garment does not conform to the body as it is intended to” (Anderson *et al.* 2000:1).

Three aspects play a role in determining consumer fit preferences. These aspects are physical comfort, psychological comfort and appearance (Anderson *et al.* 2000:1; Frost in Labat & DeLong 1990:44). These factors are discussed below with the exception of appearance which has already been discussed in terms of aesthetic behavioural characteristics.

2.4.1 Comfort as an influence on fit

Physical comfort in clothing is affected by a number of variables that originate inside and outside the body (Horn & Gurel 1981:34). Aspects that affect comfort in relation to fit include thermal comfort and psychological comfort.

2.4.1.1 Thermal comfort

When wearing clothing, the human body is affected by certain forms of heat exchange (Horn & Gurel 1981:348). During physical activity, the body burns energy in the form of kilojoules in the muscle tissue, releasing a great amount of body heat (Horn & Gurel 1981:349). Dress acts as a protective barrier from the harsh light of the sun. The physical comfort of the body can be jeopardised if clothing traps body heat, causing

perspiration and fatigue (Horn & Gurel 1981:350,360).

For warmth, the space between the layers of clothing is important (Beazley 1999:68). Static air needs to be trapped when the garment is fastened closely at the openings and garments that fit tightly may cause the wearer to feel cold. Adequate space between the body and the garment allows ventilation of air, allowing warm air to rise, keeping the body cooler under hot conditions (Beazley 1999:68).

2.4.1.2 Psychological comfort

A garment that is physically comfortable and pleasing to the individual provides psychological comfort (Kefgen & Touchie-Specht 1981:30). Psychological comfort or lack thereof may be closely related to how well the garment expresses the individual's self-image (Kefgen & Touchie-Specht 1981:32). This topic will not be discussed further, as it is not a vital aspect of this study. The physical aspects of the garment that influence consumer satisfaction with fit are explored in the next section.

2.4.2 Elements of fit

The five classic elements of fit are grain, set, line, balance and ease (originally identified by Erwin, Kinchen & Peter cited in Brown & Rice 1998:14). These five elements are highly interrelated and can be used to describe various related aspects of fit. A garment that does not have adequate wearing ease, will cause poor set and distorted grain to be visible when worn (Brown & Rice 1998:141).

2.4.2.1 Grain

Grain is the orientation of the yarns that make up the fabric (Brown & Rice 1998:114). Two sets of yarns are woven at right angles to each other to make up a fabric. The warp yarns run lengthwise and weft yarns run crosswise (DeLong 1998:141). For a garment to have a good fit, it must be cut on the grain. The vertical yarns of the fabric need to run parallel along the whole length of the body at centre front and centre back (Brown &

Rice 1998:141; Salusso-Deonier 1989:39). According to Brown and Rice (1998:141), there are five categories of grain usage in a garment, namely the lengthwise grain, the crosswise grain, the straight-off-grain, the bias and true bias as well as the off-grain.

The warp runs parallel to the finished selvage of the fabric (Rasband 1994:26; Brown & Rice 1998:102). The yarns are held taut by the loom during weaving, which means that they must be strong enough to withstand the tension of the weaving process (Brown & Rice 1998:102). These yarns are therefore more stable and less prone to stretching or shrinking as well as more reliable for hanging straight (Brown & Rice 1998:104). Designers plan most major pattern pieces to be cut with the length of the pattern pieces parallel to the warp. In this manner, the warp lies perpendicular to the floor when the garment is worn (Rasband 1994:26; Brown & Rice 2001:114).

Straight-off-grain includes both the lengthwise and crosswise grains because they follow the straight yarns of the fabric and the lengthwise grain runs straight down the body at centre front and centre back (Brown & Rice 2001:115). The crosswise grain is perpendicular to the lengthwise grain at the chest and the full hip levels (Brown & Rice 2001:115). However, the position of the pattern in relation to the grainline can be changed intentionally, to alter the way the garment hangs (Brown & Rice 2001:115).

The bias and true bias of a fabric are considered directions of the fabric rather than grain (Brown & Rice 2001:115).

A wearer's poor posture or 'body flaws' can affect the grain and cause a garment to hang incorrectly on the body (Brown & Rice 1998:141). Salusso-Deonier (1989:373) argues that the apparel industry is to blame for the majority of fit problems because only the standard posture and proportions are used to construct garment patterns. Aligning grain to posture during pattern development will save much time as opposed to attempting to adjust a pattern made for a standard posture. If the grain is incorrect for a

sample size due to incorrect posture alignment, grading out of this basic pattern block would cause major fit problems (Salusso-Deonier 1989:373).

- **Using grainline and balance to evaluate fit**

Grainline is a fabric characteristic to be considered when evaluating the fit of a garment. A well-planned garment will produce perpendicular intersections of the two fabric grains. If the yarns are not properly aligned, the garment will not present the desired effect. Even small differences of poor grain alignment can produce noticeable changes in the hang of the fabric and the fit of the garment. (Liechty *et al.* 1992:55-57). When the grain is inappropriately aligned to the garment, it changes the aesthetic and functional quality of the finished garment (Brown & Rice 1998:102).

To determine the accuracy or deviation in the garment fit, the position of the fabric grain or marked grainlines against the body need to be carefully observed. A corrected grain deviation creates balance on a symmetrical body, causing both sides of the garment to lie equally smooth and relaxed because the pull of gravity is equal. “On a basic-fitted garment, the length grain should lie perpendicular to the floor at the sides, the centre front and centre back; the crossgrain should lie parallel to the floor across the centre front and centre back” (Liechty *et al.* 1992:55).

A ‘non-standard’ figure causes the grainline to lie skew or bow because each figure variation requires a specific amount of length and width of fabric. Insufficient or excess fabric length and width can cause tension wrinkles or loose folds in the garment area and the grainline becomes distorted. The more the grainline deviates from the standard, the more it will slope or bow as fabric ease is ‘borrowed’ and pulled to another area or allowed to sag (Liechty *et al.* 1992:55-57).

2.4.2.2 Set

Set refers to a smooth fit without any undesirable wrinkles (Brown & Rice 1998:142). When a garment fits poorly to the wearer's body, wrinkles (not the type caused by wear that can be ironed out) can be formed due to poor set. Set wrinkles occur when a garment is too large or too small, causing the garment fabric to pull or hang in the area of poor fit (Brown & Rice 1998:142). Poor posture or 'body flaws' can cause inadequate set. The location and wrinkle type can determine the exact cause of poor fit.

According to Brown and Rice (1998:142,143) there are five basic types of wrinkles:

- Horizontal wrinkles under tension are caused as a result of the garment that is too tight for the body area just above or below the wrinkles, for example, pants with horizontal wrinkles at the hip level.
- Loose, horizontal wrinkles are caused by the garment being too long for the body. For example, pants on a person with a full pelvic tilt, cause the horizontal wrinkles or folds in the centre back below the waistband because the pants are longer for the body in that area.
- Loose, vertical wrinkles are caused because a garment is too big in that area. For example, vertical folds along leg length indicate that the leg width is too big.
- Vertical wrinkles under tension are caused as a result of a garment being too short in that area. For example, pants with vertical wrinkles in the crotch area indicate that the crotch seam is too short for the wearer.
- Diagonal wrinkles are caused by a body curve that is too large for the garment or because the garment lacks sufficient shaping to fit the particular body curve. For example, a baywindow causes pants to be too tight across the abdomen, forming wrinkles that point towards the curve.

2.4.2.3 Line

Line refers to the alignment of the structural lines of a garment to the natural lines of the body. Basic garment seam lines should follow the natural silhouette of the body

(Stamper *et al.* 1991:299). Certain lines outline the body while other lines encompass the circumference of the body. Singer (1989:25) provides the following standards for the alignment of the structural lines of pants with the body:

- The waistline lies on the natural waist and is parallel to the floor whether sitting or standing.
- The side seamlines are straight; they hang perpendicular to the floor and visually bisect the body.
- The hemlines for full-length pants by standards and not fashion, extend to the top of the heel at the back 25 to 50mm from the floor, and touch only the top of the shoe in the front.
- The centre front and centre back lines should fall straight down the centre front and centre back of the body (Brown & Rice 1998:143).
- The darts should appear as straight lines that follow the body parts they are intended to fit.

Poor design or construction can result in an out-of-line garment. A body that is not standard can also cause the distortion of lines on a garment (Brown & Rice 1998:143).

- **Using structural line, proportion and balance to evaluate fit**

The second indicator of the accuracy or deviation of fit in a garment is the manner in which structural line aligns with the body and divides it into pleasing proportions.

The eye is quickly drawn to any structural lines of a garment, such as darts, seams, pleats, tucks and trims. At the same time, the eye compares the garment to the corresponding vertical or horizontal centre of the body area and aligns the two. These perceptions and comparisons determine the degree of proportion and balance of the garment. Balance is achieved from visually equal garment weight, size, or the distance from the body centre line. (Liechty *et al.* 1992:55-57).

When the garment pulls or drops from its expected position on the body, the garment appears unstable and uncomfortable. Balance in a garment is distorted with an increase in the level of misallocation of structural lines or the degree of snugness or looseness to the body. The garment is in harmony with the body when all the structural lines divide the body into the correct proportions. Both the wearer and observer sense its visual and physical comfort. (Liechty *et al.* 1992:55-57).

2.4.2.4 Balance

Balance occurs when the garment is in symmetry. The left and right halves of the garment must appear balanced when viewed from the front, back and side view, in order to appear well-fitted (Brown & Rice 1998:144). Pants legs appear balanced when the fabric is evenly distributed around the legs (Singer 1989:25). Balance is related to the fit elements: grain and line (Brown & Rice 1998:144). A garment cut off grain will result in a misbalance causing the garment to hang skew on the body. If the line of the garment does not bisect the natural line of the body, the garment hangs out of balance.

A garment that fits poorly could also be unbalanced due to poor posture of the wearer, 'body flaws' and poor construction techniques (Brown & Rice 1998:144). An individual body or posture is often considered unbalanced.

2.4.2.5 Ease

Ease can be defined as the difference between the body measurement at any given point, and the apparel item or the pattern at that point (Stamper *et al.* 1991:298). The extra fabric permits the garment to accommodate natural body movements such as breathing, walking, bending etc. The amount of ease required in a garment for the purpose of comfort, movement and attractiveness, is dependent on the design, the fabric, the wearer's body, the occasion and personal preference (Rasband 1994:20).

- **Movement ease**

The term ‘**movement ease**’ can be defined as the amount of ease required to render a garment comfortable to wear (Rasband 1994:20; Brown & Rice 1998:144). Liechty *et al.* (1992:57) define movement ease as the amount of garment fabric required in addition to the circumference of the body. The measurements of the garment should be equal to the body measurements plus movement ease (Rasband 1994:158). Movement ease is also known as fitting ease, basic ease, comfort ease, garment ease (Brown & Rice 1998:143) and wearing ease (Rasband 1994:20). All garments need a minimum amount of movement ease irrespective of the style, except where stretch fabrics are used (Brown & Rice 1998:144). Without the minimal amount of movement ease, a garment is uncomfortable, appears tight and wrinkled, and wears out faster due to strain on seams and the fabric. According to Brown and Rice (1998:144), the minimum garment ease amount for men’s wear at the waist and hip is 12.5mm (Brown & Rice 1998:144).

Gioello and Berke (1979:20) give an indication of the minimal amount of movement ease required for designing men’s lower torso garments, in addition to the movement ease already included in the basic trouser blocks. This information is presented in Table 2.

TABLE 2: CHART FOR MOVEMENT EASE FOR MEN’S LOWER TORSO

Location/Area of body	Movement/Comfort ease (mm)
Waist circumference	12,7
Abdominal circumference	12,7
Hip circumference	12,7
Waist to crotch depth (front + back depth)	38,2

- **Using movement ease to evaluate fit**

Fitting ease in a garment allows the body space for all natural movement. Because movement causes expansion of the body area involved, extra fabric is required for mobility and comfort. Following a body movement, the garment should resume its natural position without needing to be adjusted. The lack of sufficient fitting ease causes

a garment to lose its flow of style and lines. The garment can appear tight and wrinkled, making the body appear unattractive instead of flattering. A garment with insufficient ease is uncomfortable to wear. Liechty *et al.* (1992:57) emphasise that a wearer cannot assume that the amount of ease allowed by a designer is sufficient for his/her body.

- **Design ease**

Rasband (1994:20) defines design ease as the degree of closeness, looseness, or fullness of fit necessary for the style. Brown & Rice (1998:144) define design ease as the extra style fullness added to movement ease.

From the viewpoint of Brown and Rice (1998:144), all garments should have movement ease, but design ease is optional because it is added merely for the sake of appearance to give a garment its 'style'. A basic-fitted garment only has movement ease, whereas in another garment, design ease may be sufficient for movement and it is not necessary to include extra movement ease (Brown & Rice 1998:159). For example, style fullness creates a full, pleated skirt rather than a straight one (Brown & Rice 1998:159). The amount of design ease added to a garment is dependent on current fashion trends (Brown & Rice 1998:159). To evaluate whether a style allows sufficient ease, a basic motor test technique can be performed to evaluate mobility (Watkins 1984:179).

2.4.3 Fit problems

The most common fit problems experienced with pants occur when the elements of fit are not in harmony. Singer (1989:34-40) identified and described the following fit problems:

- Short crotch depth: "The distance from the waistline to crotch is shorter than standard, causing pants to pull in the crotch area. Wrinkles may form, pointing to the crotch, and the waistline of pants may not reach the natural waistline."
- Long crotch depth: "The distance from waistline to crotch is longer than

standard, causing pants to hang too low and pull in the crotch area. Pants are baggy and excess folds may form just below the crotch.”

- Short legs: “Legs are shorter than standard, causing pants legs that are too long.”
- Long legs: “Legs are longer than standard, causing pants legs that are too short.”
- Small Waist: “Waist is smaller than standard, causing excess fabric at waistline. Waistline is too loose.”
- Large Waist: “Waist is larger than standard, causing a waistband that is too tight or does not close properly.”
- Small hips: “Hips are smaller than standard, causing vertical wrinkles to form in hip area and pants to bag at side seams.”
- Large hips: “Hips are larger than standard, causing wrinkles to form across hip area and pocket openings and pleats to pull open.”
- Protruding seat: “Seat protrudes more than standard, causing pants to dip in back at waistline and pull across seat. Wrinkles may form, pointing to fullness.”
- Flat seat: “Seat is flatter than standard, causing pants to sag. Pants are baggy under seat and vertical wrinkles may form in back at waistline.”
- Prominent abdomen: “Abdomen is larger than standard, causing pants to dip in front at waistline and pull across abdomen. Wrinkles may form, pointing to fullness. Side seam may pull forward, and pleats are distorted.”
- Protruding front thighs: “Thighs protruding in front more than standard, causing pants to pull across front crotch area. Horizontal wrinkles may form in crotch area. Pleats may not hang straight.”
- Knock-knees: “Legs bend towards each other at the knees. Pants rub against knee at inseam, causing diagonal lines to form; the problem may be more noticeable in the back.”
- Bowlegs: “Legs bow out from the knees down. Pants rub against leg at or below the knee at side seam, causing diagonal lines to form.”

Aldrich (1997:142) describes the following additional fitting problems for men:

- Long back: “The trousers’ waistband dips at back and there may be strain lines across the back.”
- Short back: “The trousers sag at the back, creating folds.”
- Large seat: “The trousers pull across the seat line and create strain lines at the fork. The trousers require more width across seat and more length on the fork line.”
- Leg stance: “If a man stands with an open-leg stance or a closed-leg stance, this will affect the hang of the trousers.”

Vogue (1975:416) describes the type of fit problems that occur in the instance of four main male body flaws:

- Baywindow: “...is created by excess flesh through the midriff area. In pants, it forces the waistband down across the front as the centre front length is too short to cover the extra flesh. Outseams pull forward and the inseams are strained and wrinkled.”
- Bulging hips: “...are created by fleshy pads settling on the side hips, making the body very broad at this area. In pants, wrinkles and straining are evident through the hip area, pulling outseams, while the inseams are strained, causing wrinkles.”
- Forward hip stance: “...is evident when the abdomen and hip are thrown forward causing a swayback and the chest to appear sunken. ‘Horseshoe’ wrinkles form under the buttocks and pants hit back of legs below knees.”
- Backward hip stance: “...is apparent when the hips are thrown high and toward the back. This pulls the pants’ front down, causing wrinkles as the centre back length is too short, straining the inseam. The pants cling to the legs below the knees.”

The cause of the above fit problems can be anything from inaccurate sizing systems to manufacturers' choice of fit testing methods. These fit issues are explored further in the next section.

2.4.4 Fit issues

The causes of many fit problems are discussed in the following section in terms of size related problems, garment pattern design, manufacturers, grey stuff and the wearer.

2.4.4.1 Size related problems

To understand size problems, it is important to clarify the related terminology:

- A sizing system (size roll) is a set of predetermined body sizes designated in a standard manner (Winks 1997:24).
- A size chart is the artificial division of a range of measurements into a number of sizes that aim to be convenient for wholesale production, as well as to satisfy the customer's requirements (Beazley 1999:67).
- A size designation system is a system of size labelling for a garment or accessory (Winks 1997:24).
- Key dimensions are the body dimensions that provide the framework from which size categories will ultimately be generated (Green 1981:16).
- Control dimensions are those primary body dimensions on which a sizing system is built. A control dimension predicts other relevant body dimensions and are fundamental to the definition of the body size, to assign a suitable sized garment to a wearer (Winks 1997:24).
- Secondary and tertiary dimensions are those body dimensions, other than key/control dimensions, which are required to define fully the body size and are used (together with control dimensions) by the garment manufacturer in preparation of a garment size roll (Winks 1997:24).

Sources of problems with unsuitable size designation systems and sizing systems are listed in the following section.

- Manufacturers of mass produced garments use their own size specifications based on their own customers' experience or that of the wholesaler or retailer that they supply (Winks 1997:1). The consumer is uncertain about which size to select to ensure good fit (Salusso-Deonier 1989:371; Ashdown 1998:32; Kinley 2003:19).
- Garments are sized according to arbitrary systems and not garment dimensions. This poses a problem as customers often do not understand this type of size labelling (Winks 1997:1).
- Size charts are not representative of the measurements of the population for which the garments are intended. Manufacturers copy existing size charts of other countries. Due to the variety of body shapes and sizes among various ethnic groups, this can cause major fit problems (Winks 1997:1, 24).
- Sizing clothing according to age, code, etcetera, descriptive wording such as 'small', 'medium' and 'large' is often unrelated to body size and causes customer confusion (Winks 1997:1).
- Outdated sizing systems that are based on outdated anthropometric data that do not resemble the correct body dimensions for the intended population will result in fit problems (Ashdown 1998:326).

Winks (1997:1) suggests that to minimise fit issues, garment sizing should be standardised. However, standardisation is not a viable solution if the body dimensions on which the sizing system is based, are not representative of the intended population.

2.4.4.2 Garment pattern design

Fit problems may arise when garment patterns are designed from inadequate sizing charts. A sizing system is considered to be inadequate when it is outdated, not standardised or when the garment measurements do not correlate with the target

markets' body dimensions (Winks 1997:2,13)

Fit problems are also caused when the basic pattern blocks are redesigned for the purpose of current fashion and style. These blocks are used to grade patterns into smaller and larger sizes. The amount of ease between the grade sizes is consistent and calculated according to set increments. Individually sized bodies do not however vary in set proportions. Styles that are designed for a size 8 person will not necessarily suit a size 14. The methods used by manufacturers to test the fit of garments are often also the cause of fit problems (Workman & Lentz 2000:255; Kinley 2003:19, 20).

2.4.4.3 Fit testing of manufacturers

In order for a garment to fit adequately, it must comply with given dimensional specifications (Fan *et al.* 2004:33). The most commonly used tests are fit models and dress forms (Fan *et al.* 2004:33). These methods are associated with certain advantages and disadvantages.

- **Fit models**

A fit model is a person who has body dimensions that correspond with the manufacturer's interpretation of the dimensions of their median target customer (Workman 1991:32; Workman & Lentz 2000:252; Kinley 2003:19). The fit does not resemble the target customer's measurements. Fit models are commonly used by the apparel industry because the method is based on real human body measures. The model also provides comments when the clothing is wear tested (Fan *et al.* 2004:33).

Fit models are likely to give a judgement based on subjective and qualitative preferences, which may vary from one person to another and over time (Fan *et al.* 2004:33). In addition, the reasons for selecting a specific fit model and how fit is defined and evaluated could affect the results of the fit analysis (Fan *et al.* 2004:34). Changing fashion and body images result in changes in the measurements according to

which fit models are selected (Fan *et al.* 2004:34).

- **Dress forms**

Dress forms are mannequins representing the body proportions and posture of intended wearers, and are used for draping sample garments (Salusso-Deonier 1989:371). Completed **garments are also tested** on dress forms to analyse their fit (Fan *et al.* 2004:35). Dress forms are usually produced in the standard size 10 so that the garments can later be tested by a size 10 fitting model (Salusso-Deonier 1989:371). The other sizes for the entire size range are seldom made up and wear tested as sample garments (Salusso-Deonier 1989:371).

To add to this, each apparel manufacturer has his/her own interpretation of what a standard size is and what body dimensions make up this particular size (Workman 1991:32). Certain apparel manufacturers even order dress forms to their own sizing **specifications because they use** sizing variations as a design edge (Salusso-Deonier 1989:371).

Salusso-Deonier (1989:371-372) argues the case that the dress forms of apparel industries are inaccurate when compared to real human proportions and posture. The same author has proven this by creating a dress form identical to a young woman's body and comparing this to front and side views of a body form intended to represent a young woman's body with the same body dimensions. The results showed that even though a garment tested on a body form fits perfectly, a subject with the same dimensions might not fit into the garment at all, due to the unrealistic uptight and flat shape of the form (Salusso-Deonier 1989:373). This is because the human figure does not have body contours shaped stiffly and perfectly like that of a mannequin which is used for garment design and fit testing.

2.4.4.4 Grey Stuff

The term 'grey stuff' refers to the unprocessed material used to produce test garments. This is often used as a cheaper alternative to the actual garment fabric, which is more expensive. As the actual garment fabric does not have the same fabric characteristics as that of the 'grey stuff', fit problems can occur in the final garment.

2.4.4.5 Wearer

Good fit is crucial to customer satisfaction (Brown & Rice 1998:139). The wearer/consumer's fit preferences are based upon aesthetic and functional expectations (Ashdown & DeLong 1995:48). The wearer's expectations of garment fit can be defined in terms of two aspects: The individual's personal judgement relative to how the garment looks on the body, and the perception of the comfort level of the garment based on tactile and visual response from the consumer (Alexander 2005:53).

The wearer's satisfaction with a garment is highly dependent on how he feels about his body. If a garment fits poorly and the wearer is dissatisfied with his body, then it is likely that the wearer will blame himself for not being able to fit into the garment instead of perceiving the garment to be of poor fit (Alexander 2005:54). The perception of body image can affect the wearer's social interactions (Alexander 2005:54). Various studies have proven that even though a wearer may not be close to the ideal body type, he/she remains interested in clothing that enhances self image as clothing can be viewed as the extension of the physical self (Alexander 2005:55).

A study by Alexander (2005:60) indicated the existence of a relationship between a wearer's satisfaction with his body, his body shape and the clothing benefits that the wearer will seek. A wearer's sought benefits can range from fashion image, sex appeal, figure flaw compensation and clothing preferences to fashion innovativeness (Alexander 2005:60, 61).

Other studies have used demographics, body cathexis (feelings about one's body), benefits sought from clothing (for example sex appeal, fashion innovation and body flaw compensation), and body types of the individual to investigate consumers' satisfaction with fit (Brown & Rice 1998:139; Alexander 2005:54).

Ultimately, the decision of what constitutes a good fit is dependent on the individual (Ashdown & DeLong 1995:48). Ashdown and DeLong (1995:48) conducted perception testing of apparel ease variation that concentrated on two aspects of the wearer's perceptions of fit, namely: the amount of variation in the fit of apparel that can be perceived by the wearer, and the amount of variation in fit that a consumer will find acceptable. The purpose of the study of Ashdown and DeLong (1995:48) was to quantify the aspects of fit so that the wearer's perceptions of fit would contain as little subjectivity as possible. The results of this study suggested that both perception and acceptance of fit variations differ among subjects and can vary at different areas of the body (Ashdown & DeLong 1995:48). It is vital that research regarding the targeted consumer be conducted in order to design garments that provide the correct features sought (Tate 1989:107).

In conclusion, the conceptual framework, fit perceptions of the wearer and the aspects relevant to dress must be considered in order to satisfy the wearer. Knowledge of the consumer's body can allow the ideal garment to be designed.

The literature review has provided a contextual background for the research strategy and data collection methods, which are presented in the following chapter.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

According to Fouche and Delport (2002:79) a qualitative paradigm is an antipositivistic, interpretive approach, which is idiographic and thus holistic in nature. The goal of the research design was to explore and describe the fit problems associated with the combat trousers.

A selection of predominantly qualitative data collection methods were carefully selected and developed to realise the goal and objectives of this study. According to Denzin in De Vos (2002:341), a multi-method approach can ensure triangulation for a qualitative study. The methods included: focus group interviews (ANNEXURE B), one-to-one interviews (ANNEXURE C), biographic profiling (ANNEXURE D), fit judging (ANNEXURE E), motor testing (Annexure F), photographs of subjects in their combat trousers (ANNEXURE G), somatographs (ANNEXURE H), body measuring (ANNEXURE I), garment measuring sessions (ANNEXURE J) and pattern analysis. Data gathering was conducted in two phases:

- Phase one: selection of the first sample; focus groups and biographic profiling in order to select a second phase sample.
- Phase two: data capturing methods used to describe and analyse the fit problems of the second phase sample.

3.2 POPULATION AND SAMPLE

The target population for this study was male SANDF members in the age category 18 to 35 years. This corresponds with the age category that the African Warrior Project focused on. Due to logistic problems only one military base, 10SAI (South African Infantry), was visited during November 2006 to collect data. For the first phase of the study, 60 SANDF members (in three groups of 20 subjects) were provided to participate in the focus groups. The target age group could not be reached, as the youngest SANDF

member in the sample group was 25 years and the oldest 45 years old. The ages of this sample group were therefore between 25 years and 45 years. All subjects were required to complete a biographic profiling questionnaire.

The description of the sample reflects information from the biographic profiling questionnaires, body measuring sessions and somatographs. The BMI (Body Mass Index) was calculated for the sample.

Figure 3 is a representation of the first phase sample in terms of two age categories, namely:

- Category 1: 25-35 years: 38 subjects (63 percent).
- Category 2: 36-45 years: 22 subjects (37 percent).

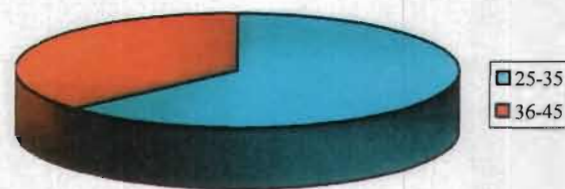


Figure 3: Presentation of the first phase sample in terms of age

From Figure 3 it is clear that the majority of the soldiers participating in the focus group interviews were between 25 years and 35 years old. Of the 60 subjects, 22 were older than the target age set for the study, but were included to reach the total number of subjects required for the first phase of the study.

A non-probability sampling technique, namely purposive sampling was employed to select the three second phase samples. From each focus group, a sample of eight

subjects was selected according to specified parameters namely height, and body shape characteristics. It was planned to use ethnicity as a parameter but this was not possible as all the subjects who were provided were Black with the exception of one Coloured.

The second phase samples were selected through visual observation. Height was the first aspect considered. With the help of the research assistant, the researcher strived to select second phase samples representative of the heights of the subjects in the particular focus groups. The subjects were asked to stand next to each other and the shortest and tallest were firstly selected.

The selection of the second phase samples for weight was conducted similarly to height, through visual observation of the subjects in the focus groups. Selection according to body shape was conducted through visual comparison using the definitions of male body shapes described by Vogue (1975:416) as key. The application of more than one parameter prevented the inclusion of an equal distribution of characteristics in every group.

The subjects from the second phase samples were measured and weighed during measuring sessions by two anthropometric experts. The somatographs (photographs of the body taken in a standard manner) were analysed to establish the most salient body characteristics of each subject (ANNEXURE H).

The second phase sample is visually presented in Figure 4 in terms of age, height, weight, BMI (Body Mass Index) and body shapes. Age is presented in the same categories as for the first phase sample:

- Category 1: 25-35 years: 14 subjects (58 percent).
- Category 2: 36-45 years: 10 subjects (42 percent).

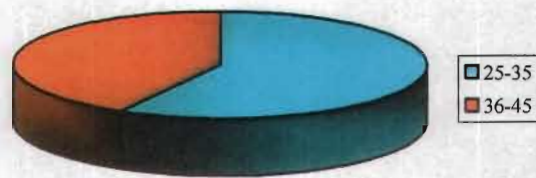


Figure 4: Presentation of the second phase sample in terms of age

From Figure 4 it can be seen that compared to the first phase sample, the distribution of subjects within the two categories is within a range of five percent.

The second phase sample is presented in terms of height in Figure 5. Height is categorized according to the standards set by the British Standards Institute (Aldrich 1997:8) into four groups:

- Category 1: extra short (X.S): 162cm and less (this group was added because certain subjects were shorter than the provided standards): three subjects (12,5 percent).
- Category 2: short (S): 162cm – 170cm: 11 subjects (48,8 percent).
- Category 3: standard/regular (R): 170cm – 178cm: eight subjects (33,3 percent).
- Category 4: tall (T) 178cm – 186cm: two subjects (8,3 percent).

The height measurements of the subjects were rounded off to the nearest 10mm.

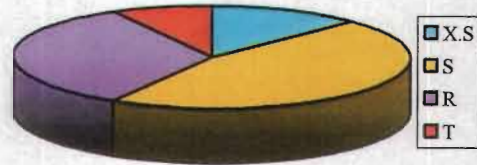


Figure 5 Presentation of the second phase sample in terms of height

From Figure 5 it can be seen that regarding height, 11 out of 24 (46 percent) of the subjects participating in the one-to-one interviews were between 1620mm to 1700mm tall.

The second phase sample is presented in terms of weight in Figure 6. The weight categories differ with 10kg, starting with 50kg and ending with 100kg:

- Category 1: 50kg – 59kg: three subjects (12,5 percent)
- Category 2: 60kg – 69kg: nine subjects (37,5 percent)
- Category 3: 70kg – 79kg: five subjects (20,8 percent)
- Category 4: 80kg – 89kg: five subjects (20,8 percent)
- Category 5: 90kg – 100kg: two subjects (8,3 percent)

The weight of the subjects was rounded off to the nearest kilogram.

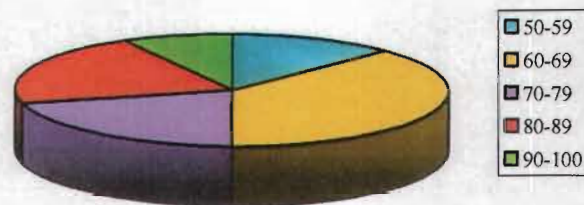


Figure 6: Presentation of the second phase sample in terms of weight

Viewing the weight distribution, it is clear that nine out of the 24 (37,5 percent) of the soldiers participating in the one-to-one interviews weighed between 60kg and 70kg. The findings of Puone *et al.* (2002:4) indicate an average weight for Black South African males for the ages 25 to 45 years as 66.3kg to 70.9kg.

The second phase sample is presented in terms of BMI in Figure 7. The BMI values of each subject were calculated to determine if the weight of the subjects was representative of their body weight distribution. The BMI of each subject was calculated by using the standard metric formula as founded by Quetelet (1846):

$$\text{BMI (kg/m}^2\text{)} = \text{weight in kilograms} / \text{height in meters squared}$$

Subjects were grouped into one of three categories:

- Group 1: BMI 18.5 – 24.9: normal weight (N): 10 subjects (41,7 percent)
- Group 2: BMI 25 – 29.9: overweight (O.W): 13 subjects (54,2 percent)
- Group 3: BMI 30 and above: obese weight (O): one subject (4,2 percent)

The BMI values of the subjects were rounded off to the nearest two decimals.

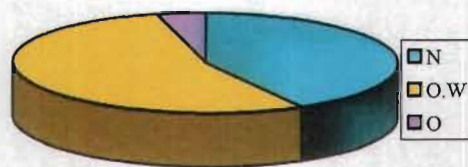


Figure 7: Presentation of the second phase sample in term of BMI

From Figure 7 it can be seen that 13 of the 24 subjects (54 percent) could be classified as overweight.

The second phase sample is presented in terms of body shapes in Figure 8. The evaluation of the somatographs assisted in determining the body shapes of the subjects. The evaluation was conducted following the guide lines of Kefgen and Touchie-Specht (1981:206-207). These authors suggest a method to evaluate the body form by means of photographs. This is done by drawing various lines on the body on the photographs, to determine the symmetry and proportion of the body.

The first four body categories are well known male 'figure flaws' as described by Vogue (1975:416) in the previous chapter. Subjects presented more than one body characteristic except in the cases where the subject had a balanced body type:

- Category 1: baywindow (B.W): 11 subjects (45,8 percent).
- Category 2: high protruding buttocks (H.P.B) (the term 'high protruding buttocks' is a preferred term of usage instead of 'bulging hips' because it is visually more descriptive of the body characteristic seen at the hip area of the subjects): 16 subjects (66,7 percent).
- Category 3: forward hip stance (F.H.S)/swayback: 14 subjects (58,3 percent).

- Category 4: backward hip stance (B.H.S): two subjects (8,3 percent).
- Category 5: balanced body (B.B). Defined by Fan *et al.* (2004:4) as the division of the various body dimensions in units of head measurements: four subjects (16,7 percent).

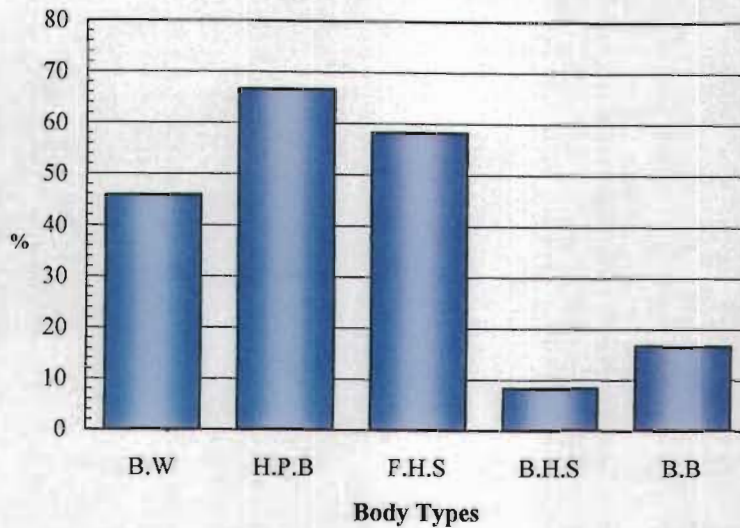


Figure 8: Description of the second phase sample in terms of body shapes

The description of the second phase sample in terms of body types presented in figure 8, indicates that 11 out of 24 subjects (almost 50 percent) have baywindows. Sixteen out of the 24 subjects (67 percent) have high protruding buttocks. Fourteen out of the 24 subjects (58 percent) have a forward hip stance, and only two out of the 24 subjects (eight percent) have a backward hip stance. Finally, only four out of 24 subjects (17 percent) have balanced bodies. The majority of the subjects (83 percent) have one or more 'figure flaw', which might have been the cause of various fit problems the subjects experienced with their combat trousers.

To summarise, the majority of the selected sample of 24 subjects were:

- Black,
- in the age group, 25-35 years,
- between 1620mm-1700mm tall,
- between 60kg-69kg in weight
- and could be classified as overweight, with high protruding buttocks and forward hip stances being the most common body characteristic.

3.3 METHODS OF DATA COLLECTION

Data was collected in the order of the two phases of the study. For the first objective, the nature of fit complaints had to be determined and interpreted in terms of wearer characteristics and activities related to aesthetic and functional aspects. For this objective, focus groups, one-to-one interviews, biographic profiling, body measuring sessions, fit checklists, motor testing photographs and somatographs were conducted.

The second objective was to analyse the design of the combat trousers in terms of size, key dimensions, proportion, balance and ease in order to establish the source of the fit problems. For the second objective focus groups, one-to-one interviews, biographic profiling, body measuring sessions, garment measuring and pattern analysis were conducted.

The third objective was to analyse the fit of the combat trousers in terms of the subjective fit preferences of the wearers, and objective fit opinions of the expert. For the third objective, focus groups, one-to-one interviews, biographic profiling and fit judging were conducted.

To counter the inexperience of the researcher as an interviewer, she was trained in the various aspects of interviewing. These included establishing rapport with subjects, coping with unanticipated problems and the rewards of interviewing in the field. In addition, the researcher received training in recording and managing large amounts of data collected during interviews. This training took place during pilot study sessions.

The advice of Greeff in De Vos (2002:293-295) regarding interviewing and communication techniques was applied and practiced. The interviewing and communication techniques helped to counter the common pitfalls listed by Greeff in De Vos (2002:295, 296).

To counter poor phrasing of questions, the researcher familiarised herself thoroughly with the relevant theory and objectives of the study. Questions were tested and refined during the pilot study sessions.

For this study, frame of reference was seen as the environment in which the subjects would function optimally. Questions and topics could not have been efficiently explored if the subjects were not provided with a comfortable and non-threatening environment. The interviews took place in the subjects' working environment with which they were familiar. The SANDF granted permission for the subjects to participate. Time was therefore set aside for the interviews. To establish rapport, the researcher started the interviews with a general opening question, for example: "How do the combat trousers look on your colleagues when they do their physical training?"

3.3.2.1 Focus group interviews

Focus group interviews are carefully planned discussions designed to obtain perceptions on a defined area of interest in a permissive, non-threatening environment (Krueger in De Vos 2002:306). The purpose of conducting focus groups was to obtain a broad idea

of the subjects' fit problems experienced and general views on the functionality of the combat trousers in their working environment(s).

There were a number of reasons why it was decided to start with focus group interviews. Most importantly, focus groups provide an atmosphere that promotes self-disclosure among participants so that they can express their viewpoints without feeling uncomfortable. Secondly, the use of focus groups is a friendly and respectful method that shows willingness to listen without being defensive. Focus groups were therefore a beneficial way for the researcher and subjects to explore and discover all aspects of the fit of the combat trousers together. Thirdly, focus groups offered an opportunity to select the second phase sample for the one-to-one interviews, and the other methods such as motor testing and measuring sessions. In line with the multi-method approach of this study, focus group interviews were followed by one-to-one interviews.

3.3.2.2 One-to-one interviews

Semi-structured one-to-one interviews were conducted "to gain a detailed picture of a subject's beliefs about, or perceptions or accounts of, a particular topic." (Greeff in De Vos 2002:302) These interviews were used to obtain detailed information on the subjects' views and personal experiences concerning the fit problems of their combat trousers.

The one-to-one interviews gave the researcher and the subjects the flexibility to follow up particular topics of interest that emerged during the focus group interviews. In this study, the subjects were experts regarding the fit problems they experienced, and therefore discussions could explore all detailed aspects of their bodies and the compatibility of the combat trousers with these.

3.3.2.3 Interview approach

The interview approach chosen for this study was the general interview guide approach. Patton in De Vos (2002:297) describes this approach as one in which basic checklists are prepared to ensure that all relevant topics are covered. This approach is also helpful in extracting information on specific topics (Greeff in De Vos 2002:297). A separate checklist was prepared for each interview type with a set of topics and questions.

To realise the goal and objectives of this study and to ensure that relevant topics were covered and correctly ordered, an operational map (ANNEXURE A) was developed. This guide was based on the conceptual framework. Some of the topics were covered during the focus group interviews as they provided a general overview of the problems experienced with the trousers.

Each checklist contained questions regarding ordered topics with topic related probes inbetween the questions. The topics used for the focus group checklist were: functionality, aesthetics, fit and organisational dress. Under functionality, comfort and mobility were discussed. Under aesthetics, style and design were discussed. Under fit, preferences in terms of functionality and aesthetics were discussed. Under organisational dress, the subject's views regarding their uniform were discussed.

For the one-to-one interviews, the relevant checklist of topics as well as themes identified during the focus groups were discussed. Themes that emerged were explored in further detail, in terms of the subject's body characteristics. For example, the topic of comfort under functionality was discussed in terms of the wearer body characteristics, namely size, body shape, age, posture, activity, weight and height.

As part of the guided approach, interview schedules were composed for each interview type as they played a major role in organising the questions. The interview schedule was a set of predetermined, open-ended questions. The interview schedules were

conducted beforehand and the researcher considered all the possible problems that could be encountered, such as questions that could be misunderstood or worded incorrectly, etc. These aspects were tried and tested during the pilot test sessions to avoid complications in the focus group and one-to-one interviews.

- **Focus group interviewing**

Three separate focus group interviews took place with one interview conducted per group. Greeff cited in De Vos (2002:312) states that three to four focus groups should be conducted per group to capture the maximum amount of relevant data possible. One interview per group was deemed adequate for this study, because the multi-method approach ensured that the follow-up one-to-one interviews covered all relevant topics in sufficient depth on a personal level. Some of the topics were also not appropriate to discuss in a focus group situation.

The sample consisted of 20 subjects per group. This relatively large number of subjects per group was chosen because a Participatory Action Research (PAR) approach to the focus group interviews was employed.

A brain storming technique was used during the focus group interviews. This technique was used to stimulate conversation among the subjects. All possible topics for discussion and their subtopics were written on large sheets of paper as they emerged during the discussion. These sheets were then pasted against a wall for subjects to look at during the focus group interview process. New topics and subtopics were added as they emerged to be used for later discussion and for other focus groups.

To save time, a group facilitator team conducted the focus group interviews. The team consisted of the researcher who took the role of the interview facilitator and the research assistant who took the role of assistant interview facilitator.

Each focus group was conducted within two hours. This is in line with Krueger (1998:49) who states that this is the physical and psychological time limit for most people.

- **One-to-one interviewing**

These interviews were planned in a follow-up sequence to the focus group interviews. Themes that were identified during the focus groups were further explored, but with a more personal and in-depth approach. This ensured that the subjects could personally follow up on what they remembered from their focus group conversations and discuss what they felt was important to explore.

The interview schedule was shown to each individual subject being interviewed. The list of topics and questions were outlined by the researcher so that the subject could decide which topic he felt most comfortable to begin with. It was not necessary to discuss all the topics from the interview schedule. The topics in the one-to-one interview schedule were more personal in terms of suitability of combat trousers to the subject's body. Personal subtopics emerged, such as the subject's waistline (tummy), crotch depth and posture.

To stimulate conversation, subjects were shown pictures of various posture and figure types. This consisted of illustrations of various types of poor fit in pants. The subject was required to indicate which picture was most representative of the fit of his trousers. This helped the researcher to determine what topics to explore with individual subjects.

3.3.3 Motor testing

Watkins (1984:179) describes motor testing as the procedure used to evaluate the satisfactory amount of garment ease available during various movement exercises. While the body was in motion, motor tests were performed in order to test the functionality of the combat trousers in terms of the amount of ease allowed to assist in

achieving the second objective of this study. A motor test technique refined by Mac Duff (2006) (an anthropometric expert on this research team), was conducted by two professionals, Bredenkamp and Mac Duff from ERGOTECH. ERGOTECH manages the SANDF database of body measurements of the SANDF members. This test is similar to other internationally used motor tests (Saul & Jaffe in Watkins 1984:179 and Fan *et al.* 2004:34) (ANNEXURE F).

3.3.4 Fit judging

The fit of the combat trousers was evaluated in terms of aesthetic appearance to realise the first objective of this study. The combat trousers were judged according to the five elements of fit discussed in the literature review.

A fit judging guide and a training manual for the fit judges were developed by the researcher to train the judges in the elements of fit and how to identify and describe problems of fit (ANNEXURE K & ANNEXURE L). Two judges, Mac Duff and Bredenkamp from ERGOTECH, evaluated the fit of the combat trousers.

To facilitate an in-depth analysis of the fit of the combat trousers, photographs (ANNEXURE G) were taken. These consisted of the front, side and back views of each of the 24 subjects. A third judge, de Klerk, a fit expert from the University of Pretoria, assisted with this analysis.

3.3.5 Somatographing and photographing

Fan *et al.* (2004:205, 206) describe somatographs as photographs taken of the human body to analyse figure type and posture. Standard image capturing discussed by Fan *et al.* (2004:205, 206) and Kuma (1999:24) was consulted to develop general guidelines for developing somatographs for this study. The following aspects were implemented with regard to this procedure:

- A light brown backdrop was used to provide a neutral background. The backdrop consisted of three access lines 30cm apart for positioning the subject.
- Markers were placed on the floor to ensure that all subjects were photographed from the same distance and angles.
- A Panasonic digital photo camera ERG00008 was positioned on a tripod one meter high (approximately the height of the crotch level) and at approximately two meters from the subject.
- Adobe PhotoShop was used to apply a mask over subject faces to each photograph and somatograph to ensure anonymity of the subjects. For the purpose of identification and data analysis, numbers were attached to the trousers or boxers.
- The subjects were photographed wearing green or black cycling shorts that were provided in sizes: small, medium, large and extra large.
- Sets of full colour somatographs were taken of each subject and included front, side and back views of the full body form (ANNEXURE H).

The researcher was trained in the procedure involved in taking somatographs by a photographic lecturer at the Vaal University of Technology (VUT).

To analyse the body forms (ANNEXURE H), a method suggested by Kefgen and Touchie-Specht (1981:206-207) was used to determine the symmetry and proportion of the body:

- Draw a vertical line bisecting the body on the front and back view, then compare differences between left and right sides of the body.
- Draw a horizontal line across the shoulders, waist, hips and knees on the front and back views, and then determine if these lines are horizontal to each other.
- Draw a straight line on each side from shoulder to hip on the front and back views, then determine if these lines taper from shoulder to hip (shoulder should be wider than the hip for a man's ideal body).

- Draw a vertical line from the ear lobe to the ankle on the side view, and then determine the distribution of body weight and posture. Similarly, weight distribution can be analysed from front and back views.
- Draw a full-length vertical line from the fullest point of the stomach to the floor on the side view, then drawing a full-length vertical line from the fullest part of the buttock to the floor. Any garment designed to hang from the waist (for example, trousers) will follow these lines. This determines how well the body conforms to the clothing design requirements.

Similar to the somatographs, photographs were taken of the subjects wearing only their combat trousers. These photographs were used for fit evaluation by an expert fit judge to provide recommendations for the visible fit problems (ANNEXURE G).

3.3.6 Body measuring sessions

Anthropometry is used as the comparative study of sizes and proportions of the human body (Norgan 1994:141). In this sense, anthropometry is considered to include size and shape (the proportionality and sizes) and the composition of the body in terms of its mass and proportions of its constituents (Norgan 1994:141).

As a major part of anthropometric data, the body measurements of the subjects need to be collected (Green 1981:16). There are two types of body measures, static and dynamic (motor testing) (Norgan 1994:143; RMSS 1994:8). In this study, only static measurements were taken. Static anthropometry is concerned with the measurement of the human subject in a rigid, standardised position so that static arm length is equal to the anatomical length (RMSS 1994:8).

Subjects were measured by two anthropometric experts, using 19 dimensions defined by ISO 8559 (1989:5-7) and the RSA-MIL-STD-127 (ANNEXURE I-1). Bredenkamp and Mac Duff, trained anthropometrists from ERGOTECH, took the measurements.

These measurements need to be taken accurately over the undergarment when the subject is in his relaxed posture (Singer 1989:24). During the body measuring, subjects wore boxer shorts in order to achieve close body measurements. To measure height, a Y701 Stadiometer was applied, for weighing, a Scale CPW 150 was used and a steel anthropometric tape was used for body measuring. In addition, the researcher prepared a measuring tape to measure crotch and inside leg lengths with greater ease and less discomfort for the subjects. The tape was constructed according to the original design by Henry (1995:1).

After taking the measurements, front and side views of the body shapes of the subjects were analysed. This could assist in determining possible fit problems before analysing the fit of the garment on the subject's body (Singer 1989:30). The somatographs were used to analyse the body form.

The measurements taken were selected for the following reasons:

- They are standard body dimensions used by, defined and described by ISO (International Standards Organisation) and ARMSCOR (Armaments Corporation) for garment development as well as for anthropometric surveying.
- To analyse the size charts provided by the ARMSCOR document (RSA-MIL-SPEC 220) consisting of key, secondary and tertiary dimensions.
- To determine if the key dimensions are correctly applied when garments are distributed to the intended wearer. The key dimensions, secondary dimensions, as well as the tertiary dimensions were necessary to analyse the amount of ease available compared to the corresponding garment measurements.

3.3.7 Garment measuring sessions

Garment measuring of the combat trousers assisted in determining the possible garment location(s) that could result in fit problem(s). Combat trousers were measured using the same measurements as the body measurements discussed above, with the exception of height and weight. The garments were measured by the researcher. The measurements of the garments were taken at the locations, as defined by the ARMSOR specifications (ANNEXURE J-1).

The garment measurements taken were compared to the ARMSCOR specifications. Also added were additional measurements, found from literature which discusses fitting problems in those areas of a garment. During garment measuring, a standard clothing measuring tape was used as well as a T-square ruler.

3.3.8 Pattern design analysing

To assist in achieving the second objective of this study, the basic blocks used for the design of the combat trousers were acquired and duplicated to compare against the basic blocks from two text books widely used in training of students in fashion and clothing, namely:

- Aldrich (1997:79): Men's standard fit pant blocks (Block 1).
- Defty (1988:526): Men's basic slacks pattern blocks (Block 2).

This was done to compare the provision of ease and shape of the patterns in order to determine possible fit problems that could be caused by the design of the basic combat trousers blocks.

3.4 DATA CAPTURING

The data capturing was also divided according to the two phases of the study. Table 3 provides information on how each method was collected and captured.

TABLE 3: DATA CAPTURING

Phase	Data Collection Method	Instruments	Capturing Method
1	Focus-group interviews	G333 Marantz digital voice recorder, card reader 526167/028 with DV/USB cable, semi-structured interview schedule	Field and observation notes, transcripts
	Biographic profiling	Questionnaire	Questionnaire
2	One-to-one interviews	G333 Marantz digital voice recorder and card reader 526167/028 with DV/USB cable, semi-structured interview schedule	Field and observation notes, transcripts
	Fitting judging	Fit checklists	Fit checklists, transcripts, photographic evidence, field and observation notes
	Body measuring	Table of measurements; steel anthropometric tapes, Y70I Stadiometer, Scale CPW 150	Table of measurements, somatographs
	Garment measuring	Table of measurements, standard clothing tape measure	Table of measurements
	Somatographs and photographs	Panasonic camera ERG00008 and 128Mb memory card, Card reader 526167/028 with DV/USB cable	Somatographs, photographs
	Motor testing	Motor test schedule	Motor test checklists
	Pattern design analysis	Measuring tables	Analysis of pattern proportions table

The description of the data analysis follows.

3.5 DATA ANALYSIS

De Vos (2002:339) defines data analysis as the process of bringing order, structure and meaning to the mass of collected data. The first step was to analyse the data simultaneously with data collection on site. The second step was to analyse data away from the data collection site, between site visits and after data collection against the background of the relevant literature. Results of the various data collection methods employed were also compared to ensure the trustworthiness of the findings. In this way, the principles of triangulation were realised. All the data was organised and coded according to keywords, which relates to the theoretical framework and operational guide (ANNEXURE A). Similarities/regularities and differences were noted to identify

emerging patterns. Where possible, qualitative data was quantified and visually presented in the form of typologies and figures, for example pie charts, diagrams etc.

3.6 SOUNDNESS OF THE STUDY

Lincon and Guba in De Vos (2002:351) refer to soundness of a qualitative study as the truth-value of the study i.e. applicability, consistency and neutrality. The same authors link these terms to credibility, transferability, dependability and confirmability as constructs that reflect the qualitative paradigm. Even though it is not possible to control all the factors influencing these aspects, as many measures as possible were employed to ensure the trustworthiness of the study including triangulation, extensive field notes, member checks and audit trails.

3.6.1 Credibility

Credibility pertains to ensuring that the method used to identify and describe the subject is as accurate as possible. The use of various methods to explore and describe the fit problem contributes to the validity of this qualitative study. To ensure that reliable information was gathered during the interviews, member checks were conducted. This assisted in ensuring credibility. In addition audit trails were kept including field notes, audiotapes, written reports and official company documents.

3.6.2 Transferability

To guide the researcher through data collection and data analysis, the researcher continuously referred back to the established conceptual framework and relevant concepts of the study. In addition, an operational map was developed to ensure that all aspects related to fit would be explored and described.

3.6.3 Dependability

The research site facilitated dependability as it provided an ideal working environment for the research team. Two separate yet proximate facilities were used for different

phases of the study. An auditorium was used for the focus groups and one-to-one interviews, providing privacy, and clarity of sound and preventing external disturbances. A large emptied office area with dress room facilities was used for the other testing methods, providing privacy for subjects changing and adequate lighting for the photographs to be taken.

3.6.4 Confirmability

Lincon and Guba cited in De Vos (2002:352) stress the need to ask whether the findings of the study could be confirmed by another similar study. The findings of this study were compared to the findings of related studies on the sizing and fit of clothing and relevant literature.

3.6.5 Ethical considerations

Ethical issues as described in the “Postgraduate Guidelines 2004” of the Vaal University of Technology (Vermeulen in Raijmakers, McFarlane, Mendonidis, Duvenage & Jordaan 2004:6), were taken into consideration for this study. This document describes the rights of the subjects regarding:

- the right to non-participation,
- the right to privacy,
- the right to remain anonymous,
- the right to confidentiality,
- the right to responsibility, and
- the right to equivalence.

In addition, the researcher submitted an application to the Ethical Committee of ARMSCOR. This application included a summary of the research procedures, as well as a description of ethical precautions that were followed during the research process.

The findings of the study follow in Chapter 4.

CHAPTER 4: RESULTS AND FINDINGS

4.1 INTRODUCTION

The findings are presented in terms of the objectives of the study. As most of the findings are interpreted against the background of the wearer characteristics of the subjects, the demographics of the subjects are firstly presented.

4.2 DEMOGRAPHICS

The wearer characteristics of each subject that participated in the second phase of the study are presented in Table 4, overleaf. The subjects are presented in numerical order.

Table 4 reflects information from the:

- Biographic profiling questionnaires (age)
- Body measuring sessions (weight and height)
- Calculated BMI values (using height and weight)
- Somatographs (body shapes).

TABLE 4: WEARER CHARACTERISTICS OF THE SECOND PHASE SAMPLE PER INDIVIDUAL

Subject no.	Age	Height (mm)	Weight (kg)	BMI	Body shapes
1	43	1606	68	26,36	Baywindow with high protruding buttocks and a forward hip stance
2	40	1610	63	24,30	Baywindow with high protruding buttocks and a forward hip stance
3	36	1665	52	18,76	Forward hip stance
5	40	1768	91	29,11	Baywindow with a forward hip stance
6	30	1683	60	21,18	Balanced body
8	39	1747	61	19,99	Backward hip stance
14	39	1720	100	33,80	Baywindow with high protruding buttocks
18	36	1651	58	21,28	Balanced body
21	34	1720	81	27,38	High protruding buttocks with a forward hip stance
22	34	1698	81	28,09	Baywindow with high protruding buttocks and a forward hip stance
23	34	1658	77	28,01	High protruding buttocks with a forward hip stance
24	34	1676	71	25,28	High protruding buttocks with a forward hip stance
27	36	1620	78	29,72	Baywindow with high protruding buttocks
28	34	1776	65	20,61	High protruding buttocks with a forward hip stance
30	32	1705	58	19,95	Balanced body
35	33	1785	81	25,42	Baywindow with high protruding buttocks and a backward hip stance
42	42	1668	68	24,44	Baywindow with high protruding buttocks and a forward hip stance
43	34	1850	87	25,42	Baywindow with high protruding buttocks and a forward hip stance
45	34	1768	85	27,19	High protruding buttocks
47	28	1737	62	20,55	Balanced body
48	33	1650	60	22,04	Forward hip stance
55	35	1575	65	26,20	Baywindow with high protruding buttocks and a forward hip stance
59	33	1625	79	29,92	High protruding buttocks
60	41	1620	77	29,34	Baywindow with high protruding buttocks and a forward hip stance
Total 24					

Table 4 presents the wearer characteristics of the second phase sample per individual. In order to obtain an overview of the wearer characteristics of the second phase sample, age was used as an independent variable to categorise wearer characteristics in terms of height, BMI and body shapes in Table 5, overleaf. Age is used as a parameter because the target age group for the African Warrior Project is between 18 to 24 years. Certain subjects were older than the target age group and therefore were separately categorised.

TABLE 5: WEARER CHARACTERISTICS IN TERMS OF AGE

Age	No.	Height (mm)				BMI (kg/m ²)				Body shapes				
		1570 – 1620 (ES)	1620 – 1700 (S)	1700-1780 (R)	1780 – 1860 (T)	Underweight	Normal	Overweight	Obese	Baywindow	High protruding buttocks	Backward hip stance	Forward hip stance	Balanced body
25 - 35	47	-	-	X	-	-	X	-	-	-	-	-	-	X
	6	-	X	-	-	-	X	-	-	-	-	-	-	X
	30	-	-	X	-	-	X	-	-	-	-	-	-	X
	35	-	-	-	X	-	-	X	-	X	X	X	-	-
	23	-	X	-	-	-	-	X	-	-	X	-	X	-
	48	-	X	-	-	-	X	-	-	-	-	-	X	-
	59	-	X	-	-	-	-	X	-	-	X	-	-	-
	55	X	-	-	-	-	-	X	-	X	X	-	X	-
	24	-	X	-	-	-	-	X	-	-	X	-	X	-
	28	-	-	X	-	-	X	-	-	-	X	-	X	-
	43	-	-	-	X	-	-	X	-	X	X	-	X	-
	45	-	-	X	-	-	-	X	-	-	X	-	-	-
	21	-	-	X	-	-	-	X	-	-	X	-	X	-
	22	-	X	-	-	-	-	X	-	X	X	-	X	-
Total	14	1	6	5	2	0	5	9	0	4	10	1	8	3
36 - 44	27	-	X	-	-	-	-	X	-	X	X	-	-	-
	18	-	X	-	-	-	X	-	-	-	-	-	-	X
	3	-	X	-	-	-	X	-	-	-	-	-	X	-
	2	X	-	-	-	-	X	-	-	X	X	-	X	-
	8	-	-	X	-	-	X	-	-	-	-	X	-	-
	14	-	-	X	-	-	-	-	X	X	X	-	-	-
	5	-	-	X	-	-	-	X	-	X	-	-	X	-
	60	-	X	-	-	-	-	X	-	X	X	-	X	-
	42	-	X	-	-	-	X	-	-	X	X	-	X	-
	1	X	-	-	-	-	-	X	-	X	X	-	X	-
Total	10	2	5	3	0	0	5	4	1	7	6	1	6	1
Grand total	24	3	11	8	2	0	10	13	1	11	16	2	14	4

For the age group 25 to 35, Table 5 indicates the following:

- Seven out of 14 subjects (50 percent) fell within the short height category (including one subject in the extra short height category).
- Nine out of 14 subjects (64 percent) had BMI values that indicated that they were overweight.
- Four out of 14 subjects (29 percent) had baywindows.
- Ten out of 14 subjects (71 percent) had high protruding buttocks.
- One out of 14 subjects (7 percent) had a backward hip stance.
- Eight out of 14 subjects (57 percent) had forward hip stances.
- Three out of 14 subjects (21 percent) had balanced bodies.

For the age group 36 to 45, Table 5 indicates the following:

- Seven out of 10 subjects (70 percent) fell within the short height category (including two subjects in the extra short height category).
- The BMI values of five out of 10 subjects (50 percent) indicated that their weight was in the normal range.
- Seven out of 10 subjects (70 percent) had baywindows.
- Six out of 10 subjects (60 percent) had high protruding buttocks.
- One out of 10 subjects (10 percent) had a backward hip stance.
- Six out of 10 subjects (60 percent) had forward hip stances.
- One out of 10 subjects (10 percent) had a balanced body.

From Table 5, it is clear that both age groups (25 to 35 and 36 to 45) are mostly comprised of short subjects. Winks (1997:9) states that the average mean height of the Black male is less than that of the White male. This proved true for this study, considering that all the subjects were Black, with the exception of one Coloured subject.

Table 5 indicates that the majority of the subjects (64 percent) in the age group 25 to 35 years were overweight. The prevalence of overweight subjects may be an indication of their lifestyle. Over-nutrition is common among the South African adult population, in particular the urbanised Black adult population (Puone *et al.* 2002:1038, 1043). Over-nutrition among South African adult Black males is a factor that could contribute to the overweight status of the subjects. It is however interesting that even though most of the subjects were overweight, only four out of the 14 subjects (29 percent) had baywindows. This indicates that the subjects did not display being overweight in their midriff areas. During the evaluation of the somatographs, it was found that these subjects carried excess weight in their buttocks and inner thigh areas.

With regard to BMI values, in the age group 36 to 45 years, 50 percent of the subjects were of normal weight and the other 50 percent were overweight (including obese). There were more overweight subjects in the younger age group than in the older age group. This could be due to older subjects having a better diet than the younger subjects.

Baywindows were evident among majority of the subjects in the age group 36 to 45 years. This body shape is evident as a typical weight-gain distribution pattern for the male body (Vella & Kravitz 2002:1); therefore, baywindows are more evident among the older age group.

The majority of the subjects in both age groups had high protruding buttocks, which are typical of African body shapes (Giddings & Boles 1990:25,26). In addition, typical of the African male body types, is the shorter height when compared with the White male body (Winks 1997:9). Morrison in Winks (1997:12) found that the ratio of the sitting height to total height of Black males is significantly less than that of the White male. This indicates proportionately greater leg length for the Black male (Winks 1997:12). It

can therefore be inferred that the body rise of the Black male is shorter than that of the White male.

It was found among both age groups that the majority of the subjects (57 and 60 percent respectively) had forward hip stances. The typical characteristics for a forward hip stance are a swayback, higher buttocks and a forward curved-out belly (Liechty *et al.* 1992:38). Another probable effect of the forward pelvic tilt is the shortened upper back length from the waist to the hip, and an increase in length from the buttock to the crotch (Liechty *et al.* 1992:38). Viewing the somatographs, the forward hip stance characteristics proved true among subjects with a forward hip stance.

The results of Table 5 indicate that wearer characteristics could have contributed to the fit problems that the subjects experienced with their combat trousers.

Further to the above, the wearer characteristics of the subjects are explored in terms of body proportions. In Table 6, overleaf, the difference between the seated body rise and inside leg-length measurements of the subjects are compared to the standard body measurements set by the British Standards Institution (BSI) (Aldrich 1997:10).

In order to compare subject body measurements with the BSI standards, the waist measurements (a determinant of trouser size) of the subjects were matched with the nearest correlating BSI standard waist measurements within a range of 1mm to 13mm. Where the waist measurements of the subjects (numbered 3, 28, 18, 47, 21, 23, 59, 35, 22, 27, 45 and 14) fell in between two BSI standard sizes, the correct corresponding measurement was calculated for the inbetween sizes. The subjects are ordered according to body waist measurements. It must be taken into consideration that subject numbered 30 was a Coloured male.

TABLE 6: BSI STANDARDS COMPARED TO SUBJECT BODY MEASUREMENTS

Subject no.	BSI Standards (mm)			Subject dimensions (mm)		
	Waist	Seated body rise	Inside leg length	Waist	Seated body rise	Inside leg length
3	680	262	765	688	215	772
28	720	266	775	719	222	846
18	720	266	775	725	230	716
30	740	268	780	730	222	802
6	740	268	780	735	195	740
48	740	268	780	750	226	742
8	740	268	780	758	235	813
47	800	274	795	795	235	816
2	820	276	800	830	233	733
24	860	280	810	848	220	760
55	860	280	810	868	190	720
21	880	282	815	880	250	788
23	880	282	815	888	235	736
1	900	284	820	891	210	715
42	900	284	820	896	210	753
43	900	284	820	904	270	904
59	920	286	820	920	237	745
35	920	286	820	922	236	812
22	920	286	820	932	230	810
27	940	286	820	942	235	723
45	940	286	820	947	224	800
60	1020	292	820	1015	205	713
5	1060	296	820	1073	185	780
14	1114	288	733	1112	242	820

Although the waist measurements of the subjects were not exactly the same as the BMI waist measurements, the following can be deduced from Table 6:

➤ Body rise:

- The body rise measurements all of the 24 subjects (100 percent) were shorter than the BSI standards (Aldrich 1997:10). The smallest and largest differences were 14mm and 111mm, respectively.

➤ Inside leg length:

- The inside leg length measurements of seven out of the 24 (29 percent) subjects (numbered 3, 28, 30, 8, 47, 43 & 14) were between 7mm and 87mm longer than the BSI standard (Aldrich 1997:10).
- The inside leg length measurements of 17 out of the 24 subjects (71 percent) were 8mm to 107mm shorter than the BSI standard (Aldrich 1997:10).

The findings support that of Morrison in Winks (1997:12) that Black males have shorter body rises, as it seems that 100 percent of the subjects did have body rises shorter than standard. The shorter body rises of the subjects could be a contributing factor to fit problems.

Contrary to the findings discussed by Winks (1997:12), 71 percent of the subjects had shorter leg lengths. However, fit problems regarding the combat trousers varied according to the suitability of the sizes issued to the subjects.

To conclude, the wearer characteristics that could influence the fit of the combat trousers are as follows:

- Within the age group 25 to 35 years, short height (including extra short), overweight BMI, high protruding buttocks and forward hip stances were most common.
- Within the age group 36 to 44, short height (including extra short), normal BMI, baywindows, high protruding buttocks and forward hip stances were most common.
- For the majority of the subjects, short body rises were common.

In the next section, the findings related to objective one are presented.

4.3 FINDINGS: OBJECTIVE ONE

The first objective stated that the nature of the fit complaints had to be determined, and interpreted in terms of wearer characteristics and activities related to aesthetic appearance and functional aspects.

The findings are presented in the following order:

- First, the general fit complaints of the subjects are summarised (focus group and one-to-one interviews). The summary is presented in order to highlight the problems that subjects experienced with the fit of the combat trousers.
- Second, in order to fully realise the first objective, the general fit complaints are compared with wearer characteristics. This was done in order to determine which subjects experienced general fit problems most often.
- Third, the complaints of the subjects regarding aesthetic appearance are summarised (focus group and one-to-one interviews). This was done to gain insight into the effects of poor fit on the aesthetic appearance of the combat trousers.
- Fourth, the objective fit checklist results are analysed to determine fit problems experienced by the subjects in terms of aesthetic appearance.
- Fifth, the fit complaints of the subjects regarding functionality are summarised (focus group and one-to-one interviews). This was done to gain insight into problems the subjects experienced with the functionality of their combat trousers.
- Sixth, the objective motor test results are compared with the wearer characteristics of the subjects. This assisted in determining which subjects experienced fit problems in terms of functionality (activities) most frequently.

TABLE 7: FOCUS GROUPS: GENERAL FIT COMPLAINTS IN TERMS OF BODY AREAS

Area	Problem	Complaints
Hip	Too bulky	<ul style="list-style-type: none"> • “When I am wearing this type of uniform I look like I am bigger than I actually am.” • “It seems as if this trouser they have been designed for women because sometimes they have curves.” • “Problems lie on sides, even if you have bums.” (<i>too wide at hips</i>)
Waist	Large waist	<ul style="list-style-type: none"> • “All the size that I have depend on the belt for myself, otherwise if I loosen the belt, I can take them off without taking off the buttons.” • “I rely on the belt to keep the trousers to my body.” • “The loops are too big (<i>long</i>) the trouser slips down.” (<i>subject demonstrated the problem</i>) • “You’ll find that if it fits you well at the waist and then you go down here (<i>hips</i>) you don’t know if it’s for women because it goes like this here (<i>curved</i>) and when it goes down its fine.” • “If you don’t wear a belt it will fall off.” • “The current pants that we are wearing, you find that if your waist is fitting perfect ... then tightens around your thighs. So what I am saying is try to balance the fitting around the waist and widen around the thighs a lot more. Most of us to get the comfort around the thighs we go for a size bigger around the waist so that it doesn’t pull too tight around the thighs. Go for one size bigger so that it can last longer and so that it doesn’t start tearing on the insides.” (<i>higher inside leg seam</i>)
Leg length	Too long	<ul style="list-style-type: none"> • “Size is good but the thing is too long, ...fits me well” • “If it fit on my waist, it either too long or too short.” (<i>leg length</i>) • “You see my height (he is tall) but this trouser(s) of mine is too long. It doesn’t matter how short you are, still too long.” • “All the trousers from the factory are too long.” (<i>comment from a tall person</i>) • “The leg length is too long for everyone, we all roll them up – it’s the fashion in the army.” • “This knee block when you are doing this (<i>kneeling</i>) it is down there.” (<i>below knee area</i>) • “The kneepads are (<i>too</i>) low, they don’t protect the knees.”
Crotch	Too deep	<ul style="list-style-type: none"> • “If I am wearing my size it does not seem as if it is my size due to this part (<i>crotch length</i>), it is a bit too long.” • “They are all the same, too long. They are designed with the same measures (<i>front and back crotch lengths</i>). Back is fine. Too much in the front.” • “Some people are flat in the back. Those that got bums, it fit them in the back.” • “Only here, starting from the thighs upwards, too big.”
Thighs	Too bulky/ Too tight	<ul style="list-style-type: none"> • “The problem I have with these trousers, you see here (<i>thighs</i>) it’s very wide” • “When you scratch at the thigh you feel it aching.” (<i>sore</i>)

It is evident from Table 7 that there are five common problems:

1. Bulkiness in the hip area
2. Large waist area
3. Too long trouser legs
4. Deep crotch
5. Tight or bulky thigh areas

The comments made during the focus groups were further explored during the one-to-one interviews. The most salient, descriptive comments are summarised in Table 8, presented overleaf. Each complaint provided is indicated with the corresponding subject number. The order in which the complaints are presented, provides an indication of the frequency with which the complaints were lodged.

TABLE 8: ONE-TO-ONE INTERVIEWS: GENERAL FIT COMPLAINTS IN TERMS OF BODY AREAS

Area	Problem	No.	Complaints
Hips	Bulkiness in the hip areas	8	• "The sides I think they design for women, because they got bigger pelvic cavity, we men, we don't have that."
		3	• "On the hips it's too much...it too loose, it open. The confidence in me changes; it changes the shape of my body."
		5	• "On the hip must have more shape (<i>straight</i>), it's seemingly for curves."
Waist	Too large	30	• "To get a nice loose fit around the thighs, you need to go for one size bigger around the waist..."
		45	• "If I'm sitting, in the back here it's a bit down; it pulls down (<i>waist</i>). You must first pull it then you sit."
		47	• "I tighten my belt so that my trousers don't fall of."
		59	• "...I cannot climb nicely, I must first put down my weapon and then I must pull up my trousers..."
	Waistband too low	42	• "The waistband must be a little higher (<i>at the back</i>) so that even if I take out my belt it still fits."
		42	• "The waistband must go a little bit up at the back...must take it a little bit higher."
Leg length	Too long	55	• "I'm a short guy the way they design it, down there (<i>leg length</i>) it's too long and I can't even cut it (<i>too make it shorter</i>). Everyday I use an elastic, chain to make it straight to fit me."
		42	• "It's too long for me."
		1	• "This portion of the knee, it should be here so that it can be straight to my knee, so that when I kneel down I should be using it. It's long so when I kneel down I only going to kneel here (<i>area above trouser knee</i>), it doesn't protect my knee from little stones."
		55	• "When you run and do physical training it's not comfortable. Here (<i>front crotch</i>) it is not right when you run. It too big by the boots you can fall sometimes, it's like a balloon."
Crotch	Too deep	43	• "When it becomes old this portion (<i>crotch front</i>) thereafter the material indicates that this is just a Chinese trouser (<i>Karate pants</i>), if I can call it that, 'so-lank'." (<i>so long</i>)
		42	• "The problem I got is long front (<i>front crotch</i>) here...it sits too low, like when I climb it give a problem."
		5	• "The shape of that 'v' (<i>crotch curve</i>) is too long. It must be like ordinary trouser like the old uniform. When you are jumping or stretching your legs, maybe the fence or the wall, this part of the bottom one (<i>crotch point</i>), it's too long so it gives you a problem. You must first pull it up and you can do the jumping...its time consuming. This curve must be made smaller, the front one." (<i>crotch curve</i>)
Thighs	Too tight	14	• "Here at the thighs is tight"
		23	• "My size fits me well, the only problem is the thighs... it tightens me"
		21	• "This trouser is my size but when I start to work, it makes abrasions here on the inside (<i>inner thigh area</i>). When I am doing the squatting, it's a little bit tight (<i>at the inner thigh</i>). Its hold me tight here." (<i>back buttock to thighs</i>)
		30	• "When you have to quickly go down it pulls tight around your thighs."
		24	• "Tight at inner thighs. It restricts me too much."

The complaints in Table 8 highlight the problems the subjects experienced with the combat trousers. A fit problem regarding “a waist that is large” was most frequently expressed. Certain subjects selected trousers that were a size or two bigger around the waist, in order to have freedom of movement around their thighs. It can therefore be inferred from the complaints of the subjects that they experienced the design as bulky. Due to the deep crotch of the combat trousers, subjects experienced restriction at the front and inner thigh areas. In addition, many of the subjects experienced chafing in the inner thigh caused by friction during movement. The chafing is a result of the fact that subjects wore their combat trousers lower on their bodies than intended (somatographs and personal observation). The waist therefore presents its own set of fit problems. Descriptive comparisons reflected an undertone of embarrassment concerning a bulky hip area.

To conclude, Table 8 depicts the comments for the one-to-one interviews, ordered from the most to the least frequently expressed complaints. Based on the one-to-one interviews, Table 8 indicates the following complaints to be most common:

1. Bulkiness in the hip areas
2. Large waist area
3. Too long trouser legs
4. Deep crotch
5. Tight or bulky thigh areas

4.3.2 General fit complaints in terms of wearer characteristics

In order to determine whether there were certain subjects that experienced more fit problems than other subjects, wearer characteristics were compared to the general fit complaints most frequently expressed in the one-to-one interviews presented in Table 9. In ANNEXURE M, a detailed table provides fit complaints for each subject, which is compared against the wearer characteristics. The total number of subjects that

experienced general fit problems is provided. Subjects (numbered 14, 28 & 48) who wore previous versions of the combat trousers are not considered.

Table 9 presents a summary of ANNEXURE M in which the following wearer characteristics, namely height, BMI and body shapes, are compared to the general fit complaints. The general fit complaints are presented in order of the most frequent to least frequent mentioned complaints. It must be taken into consideration that the complaints of the subjects were expressed in the context of their subjective experiences. Subjects may therefore only have expressed the problems they felt that hampered their daily activities and general image as soldiers in uniforms.

In Table 9, overleaf, for all categories, the highest value above 50 percent and the lowest values below 50 percent are highlighted. The highest value is highlighted in blue and the lowest in yellow. These values provide an indication of which wearer characteristics are considered to have contributed to particular problems with the combat trousers. It is important to note, that the subjects (numbered 14, 28 & 48) who wore previous versions of the combat trousers are not included in Table 9. The obese weight category is not presented because it consists only of subject number 14. The possibility that subjects could fall into more than one body shape category must be taken into consideration. The number of subjects for the body shape groups does not therefore add up to the total number of 21 subjects.

TABLE 9: GENERAL FIT COMPLAINTS IN TERMS OF WEARER CHARACTERISTICS

Wearer characteristics	Category	n	Fit complaints									
			Bulkiness in hip areas		Large / low waists		Too long trouser legs		Crotch areas that are too deep		Tightness in thigh areas	
			n	%	n	%	n	%	n	%	n	%
Height	Extra short	3	3	100	1	33	3	100	2	67	1	33
	Short	10	6	60	5	50	5	50	5	50	5	50
	Regular	6	4	67	6	100	3	50	2	33	2	33
	Tall	2	1	50	1	50	1	50	1	50	1	50
	Total	21	14	67	13	62	12	57	10	48	9	43
BMI	Normal	8	5	63	7	88	5	63	5	63	3	38
	Overweight	13	9	69	6	46	7	54	5	38	6	46
	Total	21	14	67	13	62	12	57	10	48	9	43
Body shapes	Baywindow	10	6	60	3	30	6	60	5	50	3	30
	High protruding buttocks	14	9	64	7	50	8	57	6	43	7	50
	Forward hip stance	12	8	67	7	58	9	75	7	75	5	42
	Backward hip stance	2	1	50	1	50	1	50	1	50	0	0
	Balanced body	3	1	33	2	67	1	33	0	0	1	33

The findings in Table 9 are discussed in terms of the problems experienced, starting with the problems that most frequently occurred in relation to particular wearer characteristics.

➤ Bulkiness in the hip areas:

- In terms of the height categories, all of the extra short subjects had complaints.
- In terms of the BMI categories, the most complaints were lodged by the overweight subjects.
- In terms of the body shape categories, the subjects with forward hip stances had slightly more complaints than the subjects with high protruding buttocks. Only one subject with a balanced body had a complaint regarding bulkiness in the hip area.

not the first language for the majority of the subjects. The researcher edited the statements in italics to make the meaning clearer. All the complaints regarding the aesthetic appearance of the combat trousers were expressed with equally great concern. The comments from the one-to-one interviews are indicated with the corresponding subject number.

Table 10 depicts the complaints of the focus group and one-to-one interviews regarding aesthetic appearance of the combat trousers concerning:

- The oversized hip areas which create an appearance of baggy trousers.
- Folds at the bottom hem of the legs which create an appearance of oversized leg lengths of the trousers.
- Trouser crotch areas that are too deep add to the appearance of baggy trousers.
- Subjects who perceived themselves to have a poor public image as a result of the overall poor fit of the combat trousers.

TABLE 10: SUBJECTIVE COMPLAINTS: AESTHETIC APPEARANCE

Area	Problem	Description
Hips	Oversized side hip area	<ul style="list-style-type: none"> • <i>Resembles:</i> “sack of potatoes”; “bag of money”; “a balloon”; “a tsotsi”; “woman’s trousers” and “Chinese trousers.” (<i>Karate pants</i>)
Leg length	Folds at bottom hem of leg	<ul style="list-style-type: none"> • “I’m a short guy the way they design it, down there (<i>leg length</i>) it’s too long and I can’t even cut it (<i>too make it shorter</i>). Everyday I use an elastic, chain to make it straight to fit me.” (subject 55) • “It too big by the boots ... it’s like a balloon.” (subject 55)
Crotch	Too deep	<ul style="list-style-type: none"> • “When it becomes old this portion (<i>crotch front</i>) thereafter the material indicates that this is just a Chinese trouser (<i>Karate pants</i>), if I can call it that, ‘so-lank’.” (<i>so long</i>) (subject 43) • “The shape of that ‘v’ (<i>crotch curve</i>) is too long. It must be like ordinary trouser like the old uniform.” (subject 5)
Entire trouser	Public image	<ul style="list-style-type: none"> • “When we are wearing these trousers, we look like a tsotsi. Looks like you are wearing a ‘hang-gat’ this style (<i>deep crotch</i>). This thing is hanging too low.” (<i>crotch</i>). • “When you are walking in the street and you don’t pull it up, it’s going to fall down and you look like a tsotsi.” • “This trouser make you look like an old man (<i>wrinkled</i>). It mis-shapes you.” (<i>does not conform to the body</i>) • “It must be straight so that you can look neat.” (<i>leg trunks</i>) • “I am not feeling comfortable walking in public in this uniform.” • “You cannot go to public in this uniform; I am not comfortable in it.”

It is evident from Table 10 that poor fit of the combat trousers causes the subjects to feel embarrassed in public to the extent that some of the subjects choose not to wear their uniform in public. When in uniform, the wearer is expected to be a loyal representative of the organisation and its values (Joseph 1986:85). For the uniform to be a valid certificate of legitimacy of its representatives, the public viewer must accept it as an indicator of special status (Joseph 1986:67). The question arises: can subjects with poor fit be good representatives of the SANDF and its values? The aesthetic appearance of the subjects is likely to influence the opinions of the public viewer.

In order to explore the impact of poor fit on aesthetic appearance, results from the fit judging sessions are presented in the following section.

4.3.4 Fit problems in terms of aesthetic appearance: objective viewpoints

Aesthetic appearance is the evaluation of what is being viewed (DeLong 1998:2). Two fit judges visually evaluated the fit of the combat trousers in terms of the elements of fit (grain, set, line balance and ease) using the fit checklists. The fit judges identified and described fit problems in terms of aesthetic appearance for the front, side and back views of all 24 subjects.

In Table 11, the most frequently expressed comments by the judges are presented for each subject. The total number of subjects with a specific fit problem is indicated. The wearer characteristics of the subjects were not compared to the comments of the judges, because the fit problems were viewed in general, and did not focus on a specific wearer characteristic. Subjects 14, 28 and 48 who wore previous versions of the combat trousers are not considered.

The comments of the fit judges regarding line and balance were similar and therefore presented together in Table 11. The similarities in the comments are understandable because balance is related to the fit element line (Brown & Rice 1998:144). If the line

of a garment does not bisect the natural lines of the body, the garment hangs out of balance (Brown & Rice 1998:144).

Similarly, the comments regarding ease were similar to those of the set comments, and were therefore presented together in Table 11. Set wrinkles or bulges occur when a garment is too small or too large causing the garment to pull or hang in the areas of poor fit (Brown & Rice 1998:142).

A garment may be too small or too large as a result of an insufficient amount of ease, or an abundance of ease in the areas of poor fit. No subjects had problems with grain.

With the exception of the comments regarding set with wrinkles (only commented on by one fit judge), all the comments of the fit judges corresponded to each other. The researcher evaluated the comments of the judges against the somatographs. The researcher was satisfied in all instances.

Objective viewpoints in terms of aesthetic appearance are presented in Table 11, overleaf.

It is evident from Table 11 that the following problems with aesthetic appearance occurred most frequently:

- Line/Balance (side view): trouser waists fitted high in the back and low in the front waist.
- Ease/Set folds (front view): horizontal folds formed at the bottom hem of the trouser legs.
- Ease/Set folds (back view): horizontal/diagonal folds formed from the crotch point towards the side hips.

When the researcher analysed the somatographs for the waistline imbalance, it was observed that subjects with baywindows wore their trousers lower on their front waists than the rest of the subjects. Certain subjects without baywindows however, still wore their trouser waists high in the back and low in the front. The high protruding buttocks of the subjects pulled the trousers up at the back waist position. A comment made by subject 18 was as such: “I wear all my trousers on my bums and low here (*front waist*)...it must be like that”. Comfort and preference may be the reasons for many of the subjects to wear their trousers in this manner.

According to Liechty *et al.* (1992:140,162,188), horizontal wrinkles in the crotch area are the result of pulling caused by a swayback (forward hip stance), high protruding buttocks and large front thighs. Viewing the somatographs, the subjects with swaybacks, high protruding buttocks and large front thighs experienced horizontal wrinkles in the front crotch area.

Liechty *et al.* (1992:132) state that when a garment is too large in the waist area, the waist, hip, crotch and hem lines drop below the corresponding positions on the body with the result that the fabric forms loose vertical folds. The somatographs indicated that the garment areas dropped below the intended positions due to the fact that the

subjects wore the trouser waist lower than intended. This corresponds with a picture of this problem by Liechty *et al.* (1992:132).

Liechty *et al.* (1992:132) state that when the legs of a person are too thin for a pair of trousers, the entire trouser leg areas are loose and appear too large. The fabric hangs in slight vertical folds that start at the hipline but are most apparent from the crotch to the knee line. In the instance of the subjects, the looseness of the trousers appears in diagonal folds because of large front thighs and large buttocks. This corresponds to a picture by Liechty *et al.* (1992:166,188).

The horizontal folds at the hem area of the trousers indicate that the trouser legs are too long for the subjects. Analysis of the somatographs, showed that there were fewer folds in the back hem area, because the subjects wore their trousers high on their back waists and lower on their front waists. The effects of a swayback and protruding buttocks also caused the trousers to fit higher at the back.

According to Liechty *et al.* (1992:154), when the hips of a person are too small for a garment, the fabric along the side seams is loose at the fullest part of the hips. It is possible that the combat trousers were designed to accommodate large side hips, a problem which the subjects did not have. It therefore resulted in excess bulging material on the sides of the buttocks.

According to Liechty *et al.* (1992:132), diagonal and horizontal folds on leg trunks occur as a result of protruding buttocks. The fabric fits taut over the buttocks and cups under the fuller area of the abdomen. Analysis of the somatographs indicated that the trousers of the subjects displayed diagonal and horizontal wrinkles, however **instead of cupping** under the abdomen, the trousers cupped under the fullest part of the buttocks. This could be a result of excess ease at the side hips. The excess ease could have been pulled

to the back by the larger buttocks of the subjects, resulting in a cupped area under the buttocks.

To conclude, the findings of Table 11 indicated that the fit problems most frequently expressed in terms of aesthetic appearance, are a result of the following aspects:

- The subjects preferred to wear their trouser waists high in the back and low in the front.
- The subjects with swaybacks, high protruding buttocks and large front thighs experienced horizontal pulling in the front crotch and thigh areas.
- The trouser legs appeared too long for the majority of the subjects.

In the following section, fit in terms of functionality is explored in order to understand the implications of the identified fit problems on the physical activities performed by the subjects.

4.3.5 Subjective fit complaints in terms of functionality

For a better understanding of movement difficulties, Table 12 provides selected comments expressed by the subjects regarding the problems experienced with certain body movements due to the fit of the combat trousers. The order in which the complaints are presented, provides an indication of the frequency in which the complaints were lodged.

TABLE 12: FOCUS GROUPS: FIT COMPLAINTS IN TERMS OF FUNCTIONALITY

Body motion	Description of problems
Stretching	<ul style="list-style-type: none"> • “You can’t straighten your legs.” (<i>because the crotch is too deep</i>) • “The front part is not fine (<i>crotch/upper leg front</i>). I experience a problem when lying down (bending forward) its too tight.” • “These trousers, they open up here (crotch) when you stretch your legs. Trousers are meant to be on top of the hips, not on the waist. It must relax onto the hip.”
Jumping, climbing	<ul style="list-style-type: none"> • “Training in obstacle course jump walls, climb fence, affects comfort. If you jump over it opens up at this seam (<i>crotch</i>). I have to pull this up (<i>crotch seam</i>). When I walk, this is uncomfortable. I don’t know where these sizes are coming from.” • “When you want to climb up it tears.” (<i>at the crotch point, because you can not lift your leg up properly</i>) • “Sometimes you are carrying something, weapons or anything, but now you must put them down and prepare yourself.” (<i>pull up trousers</i>) • “We work with high vehicles, when we are climbing those vehicles, this trouser is a problem, and you can not lift your leg.” • “When we have to do some movements, you have to position it first.” (<i>pull trousers up</i>)
Walking	<ul style="list-style-type: none"> • “I feel some discomfort here, (<i>inner thigh</i>) it scratch me when I walk.”
Running	<ul style="list-style-type: none"> • “They make my movements more slower.” (<i>crotch too deep, pulls on top front leg</i>) • “We don’t have freedom of movement here.” (<i>thighs</i>) • “You see like my body...when I am outside practicing, if I wear it for maybe two weeks it will start tearing. I’ve got two pair of combat trousers and maybe I wear one for two weeks and the other one for two weeks. I experience that after a month it is torn after I run.” • “This we are wearing for two to three months and here it becomes harder (<i>inside leg thigh area and crotch point</i>). After sweating from jogging it becomes uncomfortable.” (<i>chafing</i>)
Kneeling	<ul style="list-style-type: none"> • “These trousers always tear here between the legs. When I do exercises and kneel down it tears, but they say it’s my right size.”
Crawling	<ul style="list-style-type: none"> • “It’s too low and when you do excises you’ll find there is haak-en-steek (<i>large thorns</i>) when you pass through the bushes and you’ll struggle because it is too loose and it is too big.” • “This balloon trouser is a problem because when you pass through the bush they can hook you easily (<i>to thorns because it too bulky</i>). It is dangerous with obstruction and movement.”

Table 12 indicates that the subjects experienced discomfort in movement due to the bulky design. These problems were further explored in the one-to-one interviews and the findings are presented in Table 13. An indication is given of the body movement relevant to the complaint. The subject number of the soldier who lodged the complaint

is included. The order in which the complaints are presented, provides an indication of the frequency in which the complaints were lodged.

TABLE 13: ONE-TO-ONE INTERVIEWS: FIT COMPLAINTS IN TERMS OF FUNCTIONALITY

Body movement	No.	Description of problems
Sitting and jumping	23	<ul style="list-style-type: none"> “When we want to sit down, I must pull it up (<i>at the waist</i>). When I do jumping I must fold it here (<i>roll waist band over</i>) to bring it closer to me.” (<i>tighten the waist</i>)
	5	<ul style="list-style-type: none"> “When you are jumping the fence or the wall, the bottom part (crotch point), is too long. You must first pull it up and then jump ... it is time consuming.”
Crawling	30	<ul style="list-style-type: none"> “Especially when I crawl the trousers cut on the thighs inside, it bursts open.” (<i>the inner thigh seam</i>)
Kneeling and running	45	<ul style="list-style-type: none"> “Most of the time it tight when I try to move my leg, it big here (<i>thighs</i>) and long, its tightening my knees, if I move, kneel or ... running, the way it’s designed its holding.” (<i>restricting</i>)
	1	<ul style="list-style-type: none"> “This portion of the knee (<i>knee guard</i>), it should be here so that when I kneel down I should be using it. The trouser is so long, that when I kneel down, it (<i>the knee guard</i>) does not protect my knee.
Running	8	<ul style="list-style-type: none"> “They restrict me, I can not run comfortably. You have to pull (<i>the deep crotch</i>) up and adjust.”
Climbing	59	<ul style="list-style-type: none"> “When I want to climb up on the vehicle I cannot climb nicely, I must fist put down my weapons and then I must pull up (<i>the deep crotch</i>) so that I can climb up easily.”
Running and climbing	2	<ul style="list-style-type: none"> “When I am busy with physical training, wearing this combat trouser, sometimes I can have some problems, maybe we are doing something like running across, climbing obstacles, there are some part where you cannot do, move properly because of the combat trouser. Here (<i>front thigh strain</i>) it restrict me.”
Sitting	2	<ul style="list-style-type: none"> “I have to pull up my trousers to fit me, because if not it’s going to hang like that, and I’m not going to feel comfortable. I have to pull them up all the time even when I sit.”

From Table 13 it is clear that subjects experienced restriction with more than one type of body movement. Restriction of movement may be associated with the deep crotch area. This is because the combat trousers fitted too low on the body due to the subjects wearing the waist lower than intended, and with certain subjects, due to the choice of a larger trouser size. This caused a major problem, because subjects continuously needed to lift the trouser crotch for easier movement of the legs. When the subjects did not adjust the deep trouser crotch, strain was placed on their front and inner thighs,

preventing the subject from completing a full stride while running, jumping, climbing etc. In some cases, the constant strain on the trouser crotch point and inner thigh seams caused stretching and tearing of the combat trousers at the inner thighs.

To conclude, Table 12 and Table 13 depict the complaints of the focus groups and one-to-one interviews regarding functionality of the combat trousers concerning:

- The movements involved (sitting, jumping, crawling, running and climbing) which resulted in the trouser waists dropping, impression of a deep crotch, tightness in the thigh areas and knee guards being too low.
- The poor fit of the combat trousers, which resulted in discomfort and movement restriction for the subjects.
- The design of the combat trousers with regard to the deep crotch, a factor that may contribute to the poor functionality of the combat trousers.

In the following section, the relationship of the combat trousers with the body will be investigated.

4.3.6 Fit problems in terms of mobility: objective viewpoints

To gain insight regarding the functionality of the combat trousers while the subjects performed body movements, the findings of the mobility tests are presented. ANNEXURE N provides the full results of the motor test for each subject, from which Table 14 to Table 19 are derived. In ANNEXURE N, the findings for the subjects (numbered 14, 28 and 48) that wore the older version of the combat trousers are not considered.

An overview of the findings pertaining to mobility is presented in Table 14 to Table 19. The findings are presented in terms of wearer characteristics for each body movement. Percentage values are indicated for the comparison provided in Table 14 to 19.

Fit problems were identified by analysing the most frequent comments of the judges while they judged the body movements of the subjects during the motor tests. The number of subjects that experienced problems with particular body movements is indicated. The majority ratings for each motor test movement, on a scale from one to three are included. The rating scale is as follows:

- No problems (1)
- Uncomfortable but movement not restricted (2)
- Movement restricted (3)

It is important to note that during the motor tests, most subjects were not able to perform certain body motions without first pulling the trouser crotch up to allow comfort in movement without restriction. It is highly possible that if subjects were not permitted to pull up their trouser before performing the various body movements, the results would have indicated a majority rating of 3: movement restricted. In Tables 14 to 19, the ratings for “movement restricted” (3) are highlighted in red.

In most instances, the comments of the two judges were similar. In the instances where the comments of the judges differed, the comments that were most representative of the corresponding ratings were selected. The ratings allocated by the judges were consistently the same, except in a small number of instances. In these instances, the comments were reviewed and the rating most suited to the comments was selected. When no choice was obvious, both ratings were presented.

For all categories in Tables 14 to 19, the highest percentage values above 50 percent and the lowest below 50 percent are highlighted. The highest value is highlighted in blue and the lowest in yellow. This indicates the wearer characteristics of the subjects that experienced the most and the least fit problems. It is important to note, that the subjects numbered 14, 28 and 48 who wore previous versions of the combat trousers are not included in Tables 14 to 19. The obese weight category is not included because only

one subject (numbered 14) fell in this category. It is important to note that subjects could fall into more than one body shape category. The number of subjects for the body shape groups does therefore not add up to the total number of 21 subjects.

In Table 14, the motor test results are presented in terms of the kneeling movement.

TABLE 14: FUNCTIONALITY: MOTOR TEST RESULTS IN TERMS OF KNEELING

Wearer characteristics	Category	n	Problems with kneeling				
			Tightness in the thigh area		Crotch area too deep		Ratings
			n	%	n	%	
Height	Extra short	3	2	67	2	67	2
	Short	10	7	70	6	60	2
	Regular	6	5	83	6	100	2
	Tall	2	2	100	1	50	3
	Total	21	16	76	15	71	-
BMI	Normal	8	6	60	7	70	2
	Overweight	13	10	77	8	62	3
	Total	21	16	76	15	71	-
Body shape	Baywindow	10	7	70	5	50	2
	High protruding buttocks	14	11	79	9	64	3
	Forward hip stance	12	8	67	7	58	2
	Backward hip stance	2	2	100	2	100	2/3
	Balanced body	4	3	75	4	100	2

The findings of Table 14 indicate that between 71 and 76 percent of the subjects (16 out of 21 and 15 out of 21 subjects respectively) experienced discomfort in kneeling. The kneeling movement was generally experienced on a rating of two, i.e. uncomfortable but movement not restricted.

It is clear from Table 14 that in each category 50 percent and more of the subjects experienced problems kneeling with regard to:

➤ Tightness in the thigh area:

- In terms of the height categories, the subjects of tall and regular height had the most problems. The tall subjects experienced kneeling on a rating of three, therefore movement restricted.
- In terms of the BMI categories, the overweight subjects had the most problems and experienced kneeling on a rating of three, therefore movement restricted.
- In terms of the body shape categories, the subjects with backward hip stances and high protruding buttocks had the most problems and experienced kneeling on a rating of three, therefore movement restricted.

➤ Crotch area too deep:

- In terms of the height categories, the subjects of regular height had the most problems.
- In terms of the BMI categories, the subjects of normal weight had the most problems.
- In terms of the body shape categories, the subjects with balanced bodies had the most problems and equally so, or even more so, those with backward hip stances – they experienced restricted movement.

Based on visual observation, the results of the kneeling movement indicate that the trousers do not accommodate extra short subjects with shorter legs. For example, the kneepad section (intended for protection of the knee) was observed to be too low under the knee and therefore lost its purpose of protection. In addition, excess bunching of fabric on the boots caused discomfort during this movement. The lowered trouser waists and crotch areas, in combination with the larger thighs of the subjects, caused the restriction from the crotch to the front thighs during kneeling. The subjects with high

protruding buttocks experienced restricted movement possibly because the required ease for kneeling in the thigh areas was pushed back up to the buttock areas, thereby restricting the thighs during kneeling.

The results of the motor test are presented in Table 15. The findings for functionality are presented in terms of squats.

TABLE 15: FUNCTIONALITY: MOTOR TEST RESULTS IN TERMS OF SQUATS

Wearer characteristics	Category	n	Problems with squats				
			Tightness in the thigh area		Crotch area too deep		Ratings
			n	%	n	%	
Height	Extra short	3	2	67	2	67	2
	Short	10	7	70	6	60	2
	Regular	6	5	83	5	83	2
	Tall	2	2	100	1	50	1/2
	Total	21	16	76	14	67	-
BMI	Normal	8	7	88	7	88	2
	Over	13	9	69	7	54	2
	Total	21	16	70	14	67	-
Body shapes	Baywindow	10	7	70	5	50	2
	High protruding buttocks	14	10	71	8	57	2
	Forward hip stance	12	7	58	6	50	2
	Backward hip stance	2	2	100	2	100	2
	Balanced body	4	4	100	4	100	2

The results of Table 15 indicate that between 67 and 76 percent (16 out of 21 and 14 out of 21 subjects respectively) of the subjects experienced discomfort in squatting. The squatting movement was generally experienced on a rating of two, therefore uncomfortable but movement not restricted.

From Table 15 it is clear that in each category 50 percent and more of the subjects experienced problems squatting with regard to:

- Tightness in the thigh area:
 - In terms of the height categories, the subjects of tall and regular height had the most problems.
 - In terms of the BMI categories, the subjects of normal weight had the most problems.
 - In terms of the body shape categories, the subjects with backward hip stances and balanced bodies had the most problems.

- Crotch area too deep:
 - In terms of the height categories, the subjects with regular height had the most problems.
 - In terms of the BMI categories, the subjects with normal weight had the most problems.
 - In terms of the body shapes categories, the subjects with backward hip stances and balanced bodies had the most problems.

From visual observation, the results of the squats indicate that because the design of the combat trousers does not accommodate extra short subjects with shorter legs, the excess bunching of fabric on the boots caused discomfort during this movement. During movement, the trouser waists and crotch areas of the extra short subjects with shorter body rises slipped down a greater distance than for the taller subjects. This resulted in restriction of the front and inner thigh areas as well as the buttock areas. As previously

mentioned, subjects with baywindows were more likely to experience movement restrictions due to the excess weight in the midriff. In addition, the baywindows pushed the trouser waists down and caused the crotch areas to lower, resulting in the restriction of the thighs and buttocks.

In Table 16, the motor test results for functionality are presented in terms of body bends.

TABLE 16: FUNCTIONALITY: MOTOR TEST RESULTS IN TERMS OF BODY BENDS

Wearer characteristics	Category	n	Problems with body bends				
			Tightness in the thigh area		Crotch area too deep		Ratings
			n	%	n	%	
Wearer characteristics	Extra short	3	2	67	2	67	2
	Short	10	3	30	3	30	1
	Regular	6	2	33	2	33	1
	Tall	2	0	0	0	0	1/2
	Total	21	7	33	7	33	-
BMI	Normal	8	3	38	4	50	1
	Over	13	4	31	3	23	1
	Total	21	7	33	7	33	-
Body shapes	Baywindow	10	4	40	3	30	2
	High protruding buttocks	14	5	36	5	36	2
	Forward hip stance	12	4	33	5	42	2
	Backward hip stance	2	0	0	0	0	1
	Balanced body	4	2	50	2	50	1

The results of Table 16 indicate that only 33 percent (seven out of 21 and seven out of 21 subjects respectively) of the subjects experienced problems with body bends. From Table 16 it is clear that with the exception of the extra short subjects, in each category

50 percent or less of the subjects experienced problems with body bends. The average rating for body bends was one, therefore acceptable.

In Table 17, the motor test results in terms of functionality of walking are presented.

TABLE 17: FUNCTIONALITY: MOTOR TEST RESULTS IN TERMS OF WALKING

Wearer characteristics	Category	n	Problems with walking						
			Tightness in the thigh area		Crotch area too deep		Chafing at inner thighs		Ratings
			n	%	n	%	n	%	
	Extra short	3	0	0	0	0	1	33	1
	Short	10	0	0	0	0	1	10	2
	Regular	6	1	17	1	17	1	17	1
	Tall	2	0	0	0	0	1	50	2
	Total	21	1	5	1	5	4	19	-
BMI	Normal	8	0	0	0	0	0	0	1
	Over	13	1	8	1	8	4	31	2
	Total	21	1	5	1	5	4	19	-
Body shapes	Baywindow	10	0	0	0	0	3	30	1/2
	High protruding buttocks	14	1	7	1	7	4	29	2
	Forward hip stance	12	0	0	0	0	3	25	1/2
	Backward hip stance	2	0	0	0	0	0	0	1/2
	Balanced body	4	0	0	0	0	0	0	1

The results of Table 17 indicate that between five and 19 percent (one out of 21 and four out of 21 subjects respectively) of the subjects experienced problems with walking. From Table 17 it is clear that in each category, 50 percent or less of the subjects experienced problems with walking. The average rating for walking was between one and two i.e. from acceptable to uncomfortable.

In Table 18, the motor test results in terms of functionality of crawling are presented.

TABLE 18: FUNCTIONALITY: MOTOR TEST RESULTS IN TERMS OF CRAWLING

Wearer characteristics	Category	n	Problems with crawling								
			Tightness over thigh area		Crotch area too deep		Chafing on inner thighs		Trousers fall down at back waist area		Ratings
			n	%	n	%	n	%	n	%	
Height	Extra short	3	2	67	2	67	0	0	1	33	2
	Short	10	4	40	3	30	0	0	1	10	2
	Regular	6	3	50	3	50	0	0	1	17	1/2
	Tall	2	1	50	1	50	1	50	1	50	1/3
	Total	21	10	48	9	43	1	5	4	19	-
BMI	Normal	8	4	40	4	40	0	0	0	0	1/2
	Over	13	6	46	5	38	1	8	4	31	2
	Total	21	10	48	9	43	1	5	4	19	-
Body shapes	Baywindow	10	4	40	3	30	1	10	2	20	2
	High protruding buttocks	14	7	50	6	43	1	7	4	29	2
	Forward hip stance	12	5	42	4	33	1	8	4	33	2
	Backward hip stance	2	0	0	1	50	0	0	0	0	1
	Balanced body	4	3	75	3	75	0	0	0	0	2

The results of Table 18 indicate that between five and 48 percent (one out of 21 and 10 out of 21 subjects respectively) of the subjects experienced problems with crawling. From Table 18 it is clear that with the exception of the subjects of extra short height and balanced body shapes, in each category, 50 percent or less of the subjects experienced problems with crawling. The subjects of extra short height and balanced body shapes however experienced problems with tightness in the thigh areas and crotch areas that

were too deep during crawling. The average rating for crawling was two, i.e. uncomfortable but movement not restricted.

In Table 19, the motor test results in terms of sitting on a chair and reaching forward are presented.

TABLE 19: FUNCTIONALITY: MOTOR TEST RESULTS IN TERMS OF SITTING ON A CHAIR AND REACHING FORWARD

Wearer characteristics		Category	n	Problems with sitting on a chair and reaching forward										Ratings
				Tightness in the thigh area		Crotch area too deep		Chafing on inner thighs		Trousers fall down at back waist area		Bulging of fabric in crotch area		
				n	%	n	%	n	%	n	%	n	%	
Height	Extra short	3	0	0	0	0	0	0	0	0	3	100	1	
	Short	10	3	30	1	10	0	0	3	30	5	50	2	
	Regular	6	1	17	1	17	0	0	2	33	2	33	1/2	
	Tall	2	0	0	0	0	0	0	0	0	1	50	1	
	Total	21	4	19	2	10	0	0	5	24	11	52	-	
BMI	Normal	10	0	0	0	0	0	0	1	10	4	40	1	
	Over	13	4	31	2	15	0	0	4	31	7	54	2	
	Total	21	4	19	2	10	0	0	5	24	11	52	-	
Body shapes	Baywindow	10	1	10	0	0	0	0	1	10	5	50	1	
	High protruding buttocks	14	4	29	2	14	0	0	3	21	8	57	1	
	Forward hip stance	12	3	25	2	17	0	0	4	33	6	50	1/2	
	Backward hip stance	2	0	0	0	0	0	0	0	0	1	50	1	
	Balanced body	4	0	0	0	0	0	0	1	25	3	75	2	

The results of Table 19 indicate that between naught out of 21 to 11 out of 21 (naught to 52 percent) of the subjects experienced problems with sitting on a chair and reaching forward. From Table 19 it is clear that with the exception of the problem with bulging fabric in the crotch area, in each category, 50 percent or less of the subjects experienced

problems with sitting on a chair and reaching forward. The average rating for sitting on a chair and reaching forward was one, therefore acceptable.

The findings of Table 19 indicate the following findings with regard to the problem with bulging of fabric in crotch area as follows:

- In terms of the height categories, the extra short subjects had the most problems, while the subjects with regular height had the least problems.
- In terms of the BMI categories, the overweight subjects had the most problems, while the subjects with normal weight had the least problems.
- In terms of the body shape categories, the subjects with balanced bodies experienced the most problems.

To summarise the motor test results for functionality, the findings of Table 14 to Table 19 indicate the following fit problems:

- Kneeling and squats were the only movements that were problematic.
- In terms of kneeling, subjects experienced tightness in the thigh areas and a crotch that was too deep.
- In terms of squats, subjects experienced tightness in the thigh areas and a crotch that was too deep.
- The subjects that experienced problems with kneeling and squats were mainly of regular or tall height, of normal or overweight BMI and with backward hip stances or balanced body shapes.

The focus of the second objective of this research is the design of the combat trousers.

4.4 FINDINGS: OBJECTIVE TWO

The second objective stated that the design of the combat trousers needed to be analysed in terms of size, key dimensions, ease and proportion in order to determine the source of the fit problems. These findings are presented from the subjective experiences of the subjects and also the objective viewpoints of the judges.

The findings are presented in the following order:

- First, the subjective complaints during the focus group and one-to-one interviews regarding sizing and design are summarised. This assisted in gaining insight in the problems the subjects experienced with the sizing and design of the combat trousers.
- Second, to determine whether subjects received their combat trousers in the correct sizes, the waist as a key dimension was analysed against the background of the ARMSCOR specifications (RSA-MIL-SPEC 220. 2001:11) and the waist dimensions of the issued garments.
- Third, ease between the specifications/patterns and the selected body dimensions of the subjects were calculated to determine whether they had sufficient ease at the relevant body and garment locations, if the waist is the only key dimension.
- Fourth, the combat trouser patterns were compared to two other standard basic blocks to determine the pattern design differences that could influence fit.

4.4.1 Subjective viewpoints regarding sizing and design

In order to gain insight regarding possible causes for the fit problems, the most frequently expressed comments during the focus groups and one-to-one interviews are presented in Table 20. These comments highlight the problems the subjects experienced with size knowledge, sizing, size distribution, design, size allocation and quality control of the combat trousers.

In Table 20, overleaf, an indication is given regarding the problem that could result in a particular complaint. It must be taken into consideration that for the majority of the subjects, English is not the first language of the majority of the subjects. The researcher edited the statements in italics to make the meaning clearer. The order in which the complaints are presented, gives an indication of the frequency in which the complaints were lodged. The comments from the one-to-one interviews are indicated with the corresponding subject number.

TABLE 20: SUBJECTIVE COMPLAINTS: SIZING AND DESIGN OF THE COMBAT TROUSERS

Problem	Description of problems
Size knowledge	<ul style="list-style-type: none"> • “We don’t have an idea what this 85/95 is.” • “It’s simpler (<i>easier</i>) if you use civilian sizing.” • “The sizes were not truly introduced, you estimate your size.” (subject numbered 47)
Sizing	<ul style="list-style-type: none"> • “I know if I wear civilian sizes I know it is going to fit me at the length and waist.” • “I think sizes were never properly introduced to us. In fact this is my size I think its 95/75 but in the store there isn’t my size. I must go to the second option which is 95/85. That is why many people here they are not comfortable; they don’t have a proper size. The second option is the problem.”
Size distribution	<ul style="list-style-type: none"> • “The one time I go to the store and they tell me I am an 85/90 and next time I go I’m an 85/95. What are all this differences about? And they all fit me differently.” • “They don’t give you your size they give you an alternative size.” • “Some soldiers get measured. And the store man looks at you and tells you who you look more like and you get his size.” • “When you go to the store and you want to change the uniform, this trouser, this size that you going to wear, you going to wear it by that guy the big one, but you don’t look like them, the bodies are not the same, but the trouser you find the size that I am wearing easily I can wear it, that one can wear it, and that one can wear it but we are different in the body.” (<i>The storeman hands uniforms according to his comparison of the person’s size to that of another.</i>) • “One size fits all – something like that.” (<i>That is how the storeman hands out the sizes.</i>) • “Must introduce proper sizes – I do not want to wear the second option.” (<i>Bigger sizes</i>) • “For my body, because most of the trousers are big, the sizes are big in the store, most people are thinner and short, in the store they got bigger sizes.” • “We are struggling to get new uniforms. The store doesn’t have all sizes.” (subject numbered 2)
Design	<ul style="list-style-type: none"> • “My size is O.K but it is the design of the trousers, the waist is very short and this thing is hanging too low (<i>crotch</i>). This trouser, I can not wear it without the belt.” • “It doesn’t have the relevant size, even if it is the small it is too big. Too big on the sides.” (<i>Hips</i>) • “This design is a balloon sort of. The old brown goes down straight and it fits in the waist.” • “The current pants that we are wearing, you find that if your waist is fitting perfect then the dimension, then tightens around your thighs. So what I am saying is try to balance the fitting around the waist and widen around the thighs a lot more. Most of us to get the comfort around the thighs we go for a size bigger around the waist so that it doesn’t pull too tight around the thighs. Go for one size bigger so that it can last longer and so that it doesn’t start tearing on the insides.” (<i>Higher inside leg seam</i>) • “The trouser must bend with your figure, we mustn’t try shape it, if it your size it should be your size.” (<i>It should fit correctly.</i>) • “If you get the right size on the waist you will find that it’s pulling around your thighs. So to get a nice loose fit around the thighs you need to go for one size bigger around your waist to get that comfort around your thighs.” (subject numbered 30)
Size allocation	<ul style="list-style-type: none"> • “I must call my size and they give me trousers. I fit it. If it fits me just at the waist, they don’t consider thighs. They don’t measure us.” (subject numbered 23)
Quality control	<ul style="list-style-type: none"> • “Sizing is a problem. You can have two trousers with the same size, but its not going to fit you the same. Sometimes the one is longer and at the waist...too much bigger.” (subject numbered 2) • “We have tailors, but they are not introduced to us.” (<i>for the purpose of uniform alteration</i>) (subject numbered 47)

From Table 20, the complaints of the subjects indicate that poor fit could also be a result of the fact that subjects received incorrect trouser sizes. In addition, even when the correct sizes are received, the design of the combat trousers does not accommodate either the waists or the thighs of the subjects. Incorrect size labels and complicated size designation systems are also problematic.

Problems with sizing and size labelling have been common since the beginning of garment mass production (Salusso-Deonier 1989:371, Winks 1997:1, Ashdown 1998:32, Kinley 2003:19). Winks (1997:1), among many authors, states that standardisation of sizing would benefit manufacturers, distributors and customers, but will not improve garment fit. The fit of a garment is dependent on the fitting tolerances implemented by the manufacturers (Winks 1997:1).

An expression quoted by Todd (in Ashdown 2007:289), namely that military uniforms are only found in two sizes: “too small or too large”, is not far off the mark. There are multiple causes for poor sizing. Causes for poor sizing include:

- manufacturers of mass produced garments use their own size specifications,
- garments are sized according to arbitrary systems and not garment dimensions,
- size charts are not representative of the measurements of the intended population for which the garments are intended,
- sizing clothing by code is often unrelated to body size and causes customer confusion (Winks 1997:1) and lastly,
- outdated sizing systems based on outdated anthropometric data that does not resemble the correct body dimensions for the intended population, which result in fit problems (Ashdown 1998:326).

To conclude, Table 20 depicts the complaints of the focus groups and one-to-one interviews regarding sizing and design of the combat trousers as follows:

- In terms of size knowledge, subjects expressed a lack of understanding of the size designation system.
- In terms of sizing, to add to their confusion, the subjects did not know how to determine their own sizes.
- In terms of size distribution, subjects were issued “alternative sizes” due to insufficient stock in stores.
- In terms of design, it is clear that the trouser waist and thigh proportions do not correlate well with the bodies of the subjects.
- In terms of size allocation, the subjects expressed the concern that the fit of the trouser waist was the only measurement considered during size allocation.
- In terms of quality control, the combat trousers at times are labelled incorrectly or sewn incorrectly which results in different fit for two trousers of the same size.

The findings related to fit problems in terms of size allocation are discussed in the following section.

4.4.2 Size allocation in terms of the waist as a key dimension

To determine whether subjects were issued with the correct trouser sizes, the specified waist key dimensions were compared to the body waist dimensions. The waist is the only key dimension that is analysed with regard to correct size allocations because it is the only dimension used for the allocation of trouser sizes. It is the only body dimension that is provided in the ARMSCOR specifications (RSA-MIL-SPEC 220:2001:11).

The differences between the natural waist and garment waist dimensions were calculated in order to determine if there are any problems with size allocations. These differences are presented in Table 21 against the background of the ARMSCOR specifications (RSA-MIL-SPEC 220. 2001:11) which was translated from centimetres to millimetres. The ARMSCOR (RSA-MIL-SPEC 220. 2001:11) size designation is based on the hip circumference/seat, waist circumference and height of the intended wearer. The first

digit indicates the seat group, the second digit indicates the height group followed by a dash and the final garment waist dimension, i.e.:

- 55-60 Small seat 5, regular height 5, waist 600mm
- 59-60 Small seat 5, tall figure 9, waist 600mm
- 95-60 Large seat 9, regular height 5, waist 600mm
- 99-60 Large seat 9, tall figure 9, waist 600mm

The fitting ranges for code 5 - small seat or regular height; and 9 - large seat or tall, height are unknown. According to the ARMSCOR specifications (RSA-MIL-SPEC 220. 2001:11), the waist sizes increase with increments of 50mm each. This means that a pair of trousers in a particular size is supposed to fit all within a 50mm range, i.e. with a waist dimension no more than 30mm less or 20mm more than the waist dimension of the trousers.

Table 21, overleaf, presents the findings in each size specification category and is arranged from the subject with the smallest to the subject with the largest waist dimension. Table 21 indicates the number of subjects, which received either a trouser size too small, too large or the correct size, if only the waist dimension is considered. If a zero value is indicated, the waist dimension of the subject falls within the 50mm range allowed. Negative values indicate that the waist dimension of the subjects falls outside the range of 20mm larger than allowed for larger waists. Therefore, these subjects received combat trousers that were too small. Positive values indicate that the waist of the subjects falls under the 30mm smaller than allowed for smaller waists. Therefore, these subjects received combat trousers that were too big.

Three subjects (14, 28 & 48) could not be included in Table 21 because they wore the previous version of the combat trousers with a different sizing system. From the comments of the subjects during the one-to-one interviews, it was established that subjects 6, 22, 35 and 60 expressed having a good fit with the current version of the

combat trousers. The subjects with good fit must be considered to determine whether they received the correct trouser size. This determines whether the waist specifications of ARMSCOR (RSA-MIL-SPEC 220. 2001:11) are in accordance with the subjects that expressed having good fit for the combat trousers.

TABLE 21: SIZE DESIGNATION IN TERMS OF WAIST DIMENSION

Designated size	Subject no.	To fit body waist specifications (mm)	Natural waist of the subjects (mm)	Differences (specification minus subject waist) (mm)	Size allocation		
					Too small	Too large	Correct
95-70	3	670-720	688	0			X
95-70	18	670-720	725	-5	X		
55-75	30	720-770	730	0			X
55-75	2	720-770	830	-60	X		
55-80	6	770-820	735	35		X	
95-80	8	770-820	758	12		X	
95-80	47	770-820	795	0			X
95-80	42	770-820	896	-76	X		
95-85	24	820-870	848	0			X
59-85	55	820-870	868	0			X
95-85	23	820-870	888	-18	X		
95-85	1	820-870	891	-21	X		
95-85	22	820-870	932	-62	X		
55-85	27	820-870	942	-72	X		
55-90	21	870-920	880	0			X
95-90	43	870-920	904	0			X
95-90	35	870-920	922	0			X
95-90	45	870-920	947	-27	X		
95-90	60	870-920	1015	-95	X		
95-95	59	920-970	920	-2			X
95-100	5	970-1020	1073	-53	X		
Total					10	2	9

The results of Table 21 indicate that:

- Two out of 21 (nine percent) subjects (numbered 8 & 6) received trouser sizes between 12mm to 35mm too large according to the specifications.
- Ten out of 21 (48 percent) subjects (numbered 18, 2, 42, 23, 1, 22, 27, 45, 60 & 5) received trouser sizes between 5mm to 95mm too small according to the specifications.

- Nine out of 21 (43 percent) subjects (numbered 3, 30, 47, 24, 55, 21, 43, 35 & 59) received the correct trouser size according to the specified waist dimensions. Even though subjects 35 had -2mm ease, it was considered as too little to be insufficient ease and therefore subject 35 had the correct trouser size.

During the analysis of the somatographs by the researcher, it was observed that the subjects wore their combat trousers on a lower, preferred position such as the lower waist location, or even lower. This lower position could have pushed the crotch down and created the impression of a deep crotch and oversized leg lengths. Even though nine of the subjects received the correct size, these subjects (with the exception of subject 35) expressed poor fit as indicated in Table 9. This proves that the waist key dimension is not enough to indicate how a trouser would fit a subject.

Out of the four subjects (numbered 6, 22, 35 & 60) that expressed good fit, only one subject (numbered 35) received the correct trouser size according to the waist. Two subjects (numbered 22 & 60) received trouser sizes that were too small indicating that they wore their trousers on a lower position. One subject (numbered 6) received a trouser size that was too big. Considering that three out of the four subjects that expressed good fit, had received the wrong size, waist as a key dimension alone does not guarantee a good fit.

To conclude, the findings of Table 21 indicate the following:

- The majority (12 out of 21) of the subjects received sizes that were either too small or too big.
- The waist alone as a key dimension is not sufficient to determine the trouser size intended for the subject.
- Fit preferences influence the perception of the subjects with regard to which size the subject feels fits him best.

To further explore possible design problems experienced by the subjects regarding size and fit of the combat trousers, ease as an important aspect of fit is explored in the following section.

4.4.3 Provision of ease

The ease available at various garment locations is, to a great extent, determined by the key dimension/s used as predictors of the relevant body dimensions. The waist is therefore the only key dimension that is analysed in terms of ease at the various body locations. To calculate ease both body and garment measurements for a specific location must be available.

The following problems were encountered with regard to the data available for calculating ease:

- The only body measurement supplied by the ARMSCOR specifications (RSA-MIL-SPEC 220. 2001:11) for the combat trousers was the waist dimension.
- The measurements of the sample combat trousers had to be discarded as they did not match the ARMSCOR specifications (RSA-MIL-SPEC 220. 2001:11).
- The researcher had only one opportunity to visit the subjects, therefore could not return to measure the actual combat trousers issued to the subjects.

The data for the provision of ease was established from:

- The ARMSCOR specifications (RSA-MIL-SPEC 220. 2001:11).
- Body measurements of subjects.
- Combat trouser pattern measurements.

The subjects were measured by two anthropometric experts. The patterns were measured by the researcher against the ARMSCOR specifications (RSA-MIL-SPEC 220. 2001:11), and proved to be accurate. The ARMSCOR specifications (RSA-MIL-SPEC 220. 2001:11) provide specifications for the following selected garment

measurements: waist and seat. In the instance where no specifications were available, pattern measurements were used for the following dimensions: the front crotch length, back crotch length, total crotch length and thigh circumference.

The information for subjects numbered 14, 28 and 48 were not included because they wore previous versions of the combat trousers with a different sizing system.

In addition, the following information was used to assist with interpretation of the limited data that was available:

- First, in order to determine if the calculated waist ease for each subject was sufficient, it was compared to the ARMSCOR specification (RSA-MIL-SPEC 220. 2001:11). The range of ease for the waist was inferred from the fitting range for the waist of the designated size. A minimum of 0mm and a maximum of 50mm ease were therefore allowed for the waist area.
- Second, in order to determine whether it is possible to infer an ease range for available ease at the waist, the ease for the sizes worn by more than one subject was considered. The waist ease of the subjects was compared to the available ease of the nominal finished garment.
- Third, in order to establish where the provision of ease was insufficient or in excess from an objective viewpoint, the calculated ease was analysed in terms of the fit judges' comments from the motor test results in ANNEXURE N. The findings for kneeling and squats were scrutinised as the combat trousers restricted movement during these two movements. Kneeling and squats resulted in tightness in the thighs and deep crotch areas. The thigh and total crotch ease were the only aspects that were therefore considered. Subjective complaints from ANNEXURE M that were relevant, and the waist and seat dimensions, were also taken into consideration.
- Fourth, the provision of ease for the subjects with fit complaints was compared to the provision of ease for the subjects that expressed having good fit. The

provision of ease was compared at the waist, seat, front crotch, back crotch, total crotch and thigh dimensions.

The ease for selected dimensions, is presented in Table 22 overleaf, calculated by subtracting the particular subject's body dimension from the corresponding specifications or pattern dimensions. Table 22 also provides the subject number and the issued size of each subject. The table is presented according to the size designation for the different sizes.

An important factor to consider is that the subjects did not wear their trousers on the natural waist as it is intended to be worn. The amounts of ease provided in Table 22 are therefore not necessarily representative of the ease experienced when the trouser waist is worn lower on the waist as preferred.

TABLE 22: EASE FOR SELECTED GARMENT DIMENSIONS

Subject no.	Designated size	Waist circumference			Seat circumference			Front crotch length			Back crotch length			Total crotch length			Thigh circumference		
		Specifications	Subject	Ease	Specifications	Subject	Ease	Pattern	Subject	Ease	Pattern	Subject	Ease	Pattern	Subject	Ease	Pattern	Subject	Ease
30	55-75	770	730	40	1050	870	180	314	310	4	420	320	100	734	630	104	710	507	203
2	55-75	770	830	-60	1050	884	166	314	358	-44	420	335	85	734	693	41	710	544	166
6	55-80	820	735	85	1090	885	205	320	350	-30	425	300	125	745	650	95	735	520	215
27	55-85	870	942	-72	1140	1034	106	325	305	20	430	400	30	755	705	50	760	660	100
21	55-90	920	880	40	1170	1038	132	340	390	-50	443	370	73	783	760	23	780	622	158
55	59-85	870	868	2	1140	940	200	325	312	13	430	320	110	755	632	123	760	570	190
60	59-90	920	1015	-95	1170	948	222	340	310	30	443	355	88	783	665	118	780	610	170
3	95-70	720	688	32	1070	835	235	330	310	20	430	325	105	760	635	125	720	491	229
18	95-70	720	725	-5	1070	867	203	330	330	0	430	330	100	760	660	100	720	555	165
8	95-80	820	758	62	1150	863	287	340	305	35	440	355	85	780	660	120	765	513	252
47	95-80	820	795	25	1150	890	260	340	320	20	440	320	120	780	640	140	765	532	233
42	95-80	820	896	-76	1150	926	224	340	325	15	440	350	90	780	675	105	765	565	200
24	95-85	870	848	22	1200	969	231	345	330	15	445	410	35	790	740	50	790	600	190
23	95-85	870	888	-18	1200	1022	178	345	380	-35	445	340	105	790	720	70	790	600	190
1	95-85	870	891	-21	1200	960	240	345	330	15	445	340	105	790	670	120	790	581	209
22	95-85	870	932	-62	1200	1005	195	345	325	20	445	340	105	790	665	125	790	620	170
43	95-90	920	904	16	1230	1015	215	360	370	-10	458	360	98	818	730	88	810	618	192
35	95-90	920	922	-2	1230	992	238	360	395	-35	458	325	133	818	720	98	810	597	213
45	95-90	920	947	-27	1230	1036	194	360	345	15	458	355	103	818	700	118	810	632	178
59	95-95	970	920	50	1250	1018	232	375	320	55	470	365	105	845	685	160	830	623	207
5	95-100	1020	1073	-53	1290	1087	203	385	395	-10	478	355	123	863	750	113	860	654	206

A comparison of the waist ease to the ease range (0mm to 50mm) in Table 22 clearly indicates that:

- Two out of 21 subjects (numbered 6 & 8) had excess of ease between 12mm and 35mm.
- Ten out of 21 subjects (numbered 18, 2, 42, 23, 1, 22, 27, 45, 60 & 5) had insufficient ease that varied between 5mm and 95mm.
- Nine out of 21 subjects (numbered 3, 30, 47, 24, 55, 21, 43, 35 & 59) had sufficient ease.

In order to establish whether an ease range could be inferred, the calculated waist ease of the subjects (in sizes with more than two subjects) was compared to the ease range (0mm to 50mm) for the waist:

- Of the three subjects (numbered 8, 47 & 42) wearing size 95-80, subject 8 had 12mm excess ease; subject 47 had sufficient ease and subject 42 had 76mm less than the established ease range.
- Of the four subjects (numbered 24, 23, 1 & 22) wearing size 95-85, subject 24 had sufficient ease and subjects 23, 1 and 22 had between 18mm and 62mm less than the established ease range.
- Of the three subjects (numbered 43, 35 & 45) wearing size 95-90, subjects 43 and 35 had sufficient ease and subject 45 had 27mm less than the established ease range.

From the analysis of the calculated ease in Table 22, in terms of the objective comments of the judges (see ANNEXURE N) and the relative subjective comments (see ANNEXURE M) regarding ease at the thigh and crotch areas, the following is clear:

- In terms of the kneeling movement, 16 out of 21 subjects (numbered 2, 1, 6, 23, 59, 24, 27, 18, 42, 30, 45, 21, 8, 5, 35 & 43) had between 100mm and 252mm of thigh ease.

- During the kneeling movement, nine of out 16 subjects (numbered 2, 23, 59, 24, 27, 18, 30, 21 & 43) that had problems with thigh ease according to the judges, also complained of tightness in the thigh area. These subjects had between 100mm and 207mm ease at the thighs.
- In terms of the kneeling movement, 15 out of 21 subjects (numbered 2, 1, 6, 23, 59, 24, 18, 42, 47, 30, 45, 21, 8, 5 & 35) had between 41mm and 160mm of total crotch ease.
- During the kneeling movement, eight of 15 subjects (numbered 2, 23, 59, 18, 42, 8, 5 & 35) that had problems with crotch ease according to the judges, also complained of deep crotch areas. These subjects had between 41mm and 160mm total crotch ease.
- In terms of the squatting movement, 16 out of 21 subjects (numbered 2, 1, 6, 23, 59, 24, 27, 18, 42, 47, 30, 45, 8, 5, 35 & 43) had between 100mm and 252mm of thigh ease.
- During the squatting movements, eight of 16 subjects (numbered 2, 23, 59, 24, 27, 18, 30 & 43) that had problems with thigh ease according to the judges, also complained of tightness in the thigh areas. These subjects had between 100mm and 207mm thigh ease.
- In terms of the squatting movement, 15 out of 21 subjects (numbered 2, 1, 6, 23, 59, 24, 18, 42, 47, 30, 45, 8, 5 & 35) had between 41mm and 160mm of total crotch ease.
- During the squatting movement, six out of 21 subjects (numbered 2, 23, 59, 24, 18 & 30) that had problems with crotch ease according to the judges and also complained of deep crotch areas. These subjects had between 41mm and 160mm total crotch ease.

The comparison of the waist, seat, crotch and thigh ease of subjects with fit complaints, to the subjects (numbered 6, 22, 35 & 60) that expressed having good fit indicate the following:

- Thirteen out of 21 subjects (numbered 2, 23, 59, 18, 3, 42, 47, 30, 45, 21, 8, 5 & 43) that complained of large/low waists had between -76mm and 62mm waist ease.
- For the waist, the subjects that expressed having good fit had between -95mm and 85mm of ease.
- Fourteen out of 21 subjects (numbered 55, 2, 1, 23, 59, 24, 27, 18, 3, 30, 45, 8, 5 & 43) that complained of bulkiness in the hip areas had between 106mm to 287mm of seat ease.
- For the seat, the subjects that expressed having good fit had between 195mm to 238mm of ease.
- Ten out of 21 subjects (numbered 55, 2, 23, 59, 18, 3, 42, 8, 5 & 43) that complained of deep crotch areas had between 41mm to 160mm amounts of total crotch ease.
- For the total crotch, the subjects that expressed having good fit had between 95mm to 125mm of ease.
- Nine out of 21 subjects (numbered 2, 23, 59, 24, 27, 18, 30, 21 & 43) that complained of tightness in the thigh areas had between 100mm to 207mm of thigh ease.
- For the thigh, the subjects that expressed having good fit had between 170mm to 215mm of ease.

The findings for the provision of ease indicate that the majority (10 out of 21) of the subjects experienced insufficient ease at the waist when compared to the ease of the ARMSCOR specifications. There were 10 subjects (numbered 18, 2, 42, 23, 1, 22, 27, 45, 60 & 5) that had insufficient amounts of ease at the waist and six subjects (numbered 18, 2, 42, 23, 45 & 5) that had general fit complaints regarding a large/low waist. This

contradiction infers that these subjects could have experienced excess ease because they preferred to wear their trouser waists lower on their waist, which could be smaller in circumference than their natural waists.

In the instance of the possibility of size related problems, the majority (three out of four) of the subjects in size 95-85 had insufficient ease at the waist.

The findings of the objective viewpoints regarding thigh and total crotch ease that are problematic indicate ease ranges of 100mm to 252mm of thigh ease, and 41mm to 160mm of total crotch ease. The analysis of the subjective viewpoints regarding the thigh and crotch ease that are problematic indicated ease ranges of 100mm to 252mm of thigh ease, and 41mm to 160mm of total crotch ease. The subjective and objective ease ranges therefore correspond to one another. It can therefore be inferred from the objective and subjective viewpoints that the thigh and total crotch areas do not provide sufficient ease for comfortable movement.

Furthermore, the motor test results and general fit complaints indicate that tightness in the thigh areas creates the impression of insufficient ease for the thighs. It is however possible that the deep crotch caused restriction in the thigh areas, creating a false impression of insufficient ease for the thighs. Based on the motor test results and general fit complaints, deep crotch areas created the impression of excess ease at the crotch. It is however possible that because the subjects chose to wear their trousers lower than intended, the crotch automatically shifted downwards creating a false impression of excess ease at the crotch.

When the ease findings of the subjects that had general fit complaints are compared to the subjects that expressed good fit, the provision of ease for the waist, seat, crotch, total crotch and thigh overlap. This indicates that the combat trousers of the subjects with fit complaints did not necessarily provide the incorrect amounts of ease although ease could

have been available at the incorrect areas with regard to their body shapes. Moreover, it is important to remember that the provision of sufficient ease is dependent on the subject's preference of good fit (Ashdown & DeLong 1995:47, 48).

To conclude, the following may be inferred from the findings for the provision of ease:

- Waist, as the only key body dimension, is not enough to establish sufficiency of ease for the rest of the relevant garment locations.
- Insufficient or excess ease is not a size related problem.
- According to the ARMSCOR specifications (RSA-MIL-SPEC 220. 2001:11) the majority of the subjects (10 out of the 21) had insufficient ease at the waist.
- From objective and also subjective viewpoints, it was determined that the thigh and total crotch ease is not sufficient.
- The subjects' preferences to wear their trouser waists lower than the intended waist position could create the impression of problems with ease, such as tightness in the thighs and crotch areas that are too deep.
- Ease could be provided at the incorrect areas for the typical body shapes of the subjects.
- The perception regarding what sufficient ease is, is influenced by the subjects' viewpoints regarding good fit.

To further investigate the possible causes of poor fit, the pattern design of the combat trousers is analysed in the following section

4.4.4 Pattern analysis

To establish whether the proportions of the patterns contributed to the fit problems with the trousers, the combat trouser pattern (illustrated in red) was analysed. It was done by comparing the pattern to two basic block designs from well known pattern design handbooks. The following basic blocks were used for comparison:

- Block 1: standard fit pant blocks for males (illustrated in blue) by Aldrich (1997:79).
- Block 2: basic slacks pattern blocks for males (illustrated in green) by Defty (1988:526).

The pair of combat trousers that was provided for use by the researcher was a size 95-90, implying a waist dimension of 900mm. Block 1 and Block 2 were therefore drafted according to the measurements for a 900mm waist. The comparison between the three patterns is visually presented in Figure 9.

The combat trouser patterns were not analysed in terms of leg length because they are provided in short and long leg lengths. The knee ease can be inferred from thigh ease and is therefore not analysed.

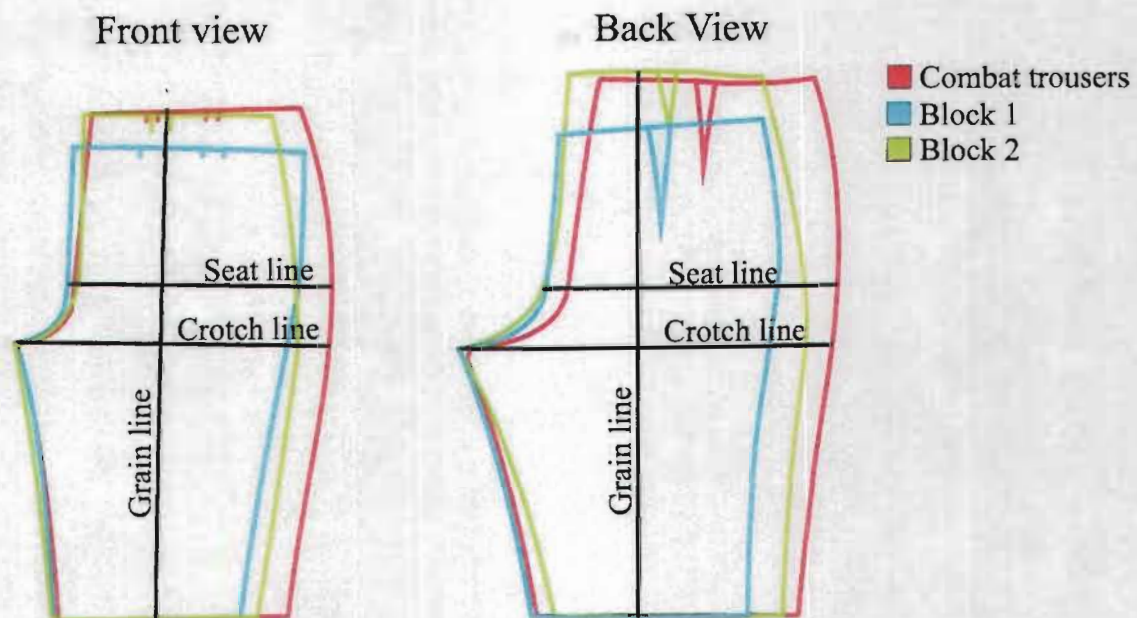


Figure 9: Comparison of the combat trouser patterns to two basic pattern blocks

The results of the comparison of the three trouser blocks in Figure 9 are summarised in Table 23. In Table 23, the differences between the three trouser blocks are described for the front and back view of the patterns.

TABLE 23: RESULTS OF THE COMBAT TROUSER PATTERNS COMPARED TO TWO BASIC PATTERN BLOCKS

View	Area	Differences	Description
Front	Waist	Control of fullness	<ul style="list-style-type: none"> Block 1 has two standard size pleats (35mm and 30mm). Block 2 has one dart. The combat trousers have two smaller pleats (15mm each).
		Positioning	<ul style="list-style-type: none"> The waistline of Block 1 is almost 50mm lower than that of Block 2 and that of the combat trousers.
	Seat	Shape	<ul style="list-style-type: none"> The combat trouser hip curve shape is more rounded compared with Block 1 and Block 2.
		Ease	<ul style="list-style-type: none"> The combat trousers have approximately 50mm more ease compared to the Block 1 and Block 2. The combat trousers provide in total an extra 100mm of ease for the entire front when compared to Block 1 and Block 2.
	Crotch	Size	<ul style="list-style-type: none"> There are no significant differences between the front crotch curves, except that the crotch curve of Block 1 is shorter due to the lower waistline.
	Thigh	Ease	<ul style="list-style-type: none"> The combat trousers have approximately 50mm more ease compared to the two basic blocks. The combat trousers provide in total an extra 100mm of ease for the entire front thigh location when compared to the Block 1 and Block 2.
Back	Waist	Control of fullness	<ul style="list-style-type: none"> Block 1 and Block 2 have darts that are between 30mm to 50mm longer than the combat trouser darts.
		Positioning	<ul style="list-style-type: none"> The waist of Block 1 is approximately 60mm lower than the waists of Block 2 and the combat trousers.
	Seat	Ease	<ul style="list-style-type: none"> The combat trousers have approximately 40mm more ease compared to Block 1 and Block 2. In total, the combat trousers provide an extra 80mm of ease for the entire back seat when compared to Block 1 and Block 2.
	Crotch	Size	<ul style="list-style-type: none"> Block 1 has a shorter crotch curve due to the lower waistline.
		Shape	<ul style="list-style-type: none"> The combat trousers have a low, deeper crotch curve compared to Block 1 and Block 2.
	Thigh	Ease	<ul style="list-style-type: none"> The combat trousers have approximately 40mm to 70mm more ease compared to Block 1 and Block 2. In total, the combat trousers provide in total an extra 80mm to 140mm for the entire back thigh when compared to Block 1 and Block 2.

The results of Table 23 are discussed in terms of the impact that the design differences of the combat trousers might have on the typical body shapes of the subjects. The results are discussed in order of the trouser block areas.

- Regarding the front waist area:

The smaller pleats of the combat trousers affect the aesthetic appearance because the pleats appear more like creases (see ANNEXURE G). The high waist of the combat trousers could be uncomfortable for subjects with baywindows and forward hip stances because they prefer to wear their trousers lower on the trunk. The higher waist could be the result of bunching of fabric in the crotch area. The lower waist of the block in Aldrich (1997:79) is probably more suitable for the body shapes of the subjects.

- Regarding the back waist area:

The combat trousers have shorter darts. This implies that less fullness is taken out of the back seat area in the combat trousers. The impact of a shorter dart is probably minimal. Most of the subjects had high protruding buttocks, for which a shorter dart is likely to be better suited. The lower waistline of the block in Aldrich (1997:79) would not be suitable for the high protruding buttocks of the subjects. A higher back waist is suggested.

- Regarding the front hip/seat area:

The rounded hip curve of the combat trousers is not suitable for the male figure because most males do not have rounded side hips. Rounded hips are a result of fat deposits, typical of the female figure type known as the pear shape figure (Vella & Kravitz 2002:1). It seems as if the rounded hip curve is the result of the 50mm additional ease in the front hip location when compared to the other two basic pattern blocks. Considering that the majority of subjects have high

protruding buttocks and not large side hips, it can be stated that the front hip/seat ease is added in the wrong areas.

- Regarding the back hip/seat:

There is an excess amount of ease. The combined excess of ease in the front and back hip/seat areas provide support for the subjects' statements regarding "balloon-like" appearance of the combat trousers.

- Regarding the back crotch area:

The shape of the crotch curve of the combat trousers differs from that of the other two basic pattern blocks. The back crotch curve of the combat trousers is low and deeper. According to Schofield, Ashdown, Hethron, LaBat and Salusso (2006:150,151), in order to provide better fitting trousers for fuller buttocks, the following alterations are required: first the back crotch length is angled out by creating a wedge that is opened at the back crotch seam on the hipline; second the back crotch seam is lengthened horizontally at the inside leg seam.

Considering that majority of the subjects have high protruding buttocks, the deepened back crotch of the combat trousers pattern should have provided a better fit over their fuller buttocks. However, because the subjects also have high buttocks, the deepened curve of the back crotch seam on the combat trousers could be positioned too low in order to provide good fit over the high buttocks of the subjects.

- Regarding the front and back thigh area:

It would appear that the combat trousers have more thigh ease than Block 1 and Block 2. Keeping in mind that many of the subjects had large front thighs, the excess amount of ease on the sides of the trousers might not provide ease where it is required. The excess ease would rather contribute to the "balloon" appearance of the trousers.

In conclusion, the following may be inferred from the pattern analysis:

- The high waistline of the combat trouser design is not compatible with the wearing preferences of the subjects. The subjects therefore pushed the waist down, which caused the deep crotch.
- The curved side hip of the combat trouser design could be the cause of its bulky appearance.
- The deep back crotch curve of the combat trouser design does not accommodate the high, full buttocks of the subjects.
- The combat trousers provide ease at the incorrect body locations, i.e. waist, seat, thigh and crotch areas.
- The provision of ease from the side of the waist to the thigh is more than standard.

The overall fit of the combat trousers is further discussed under the findings of objective three.

4.5 FINDINGS: OBJECTIVE THREE

The third objective stated that the fit of the combat trousers needed to be analysed and interpreted against the subjective fit preferences of the wearers, and objective fit opinions of the fit expert.

The findings of the third objective are presented in the following order:

- First, the comments of the subjects from the one-to-one interviews are summarised to determine the fit preferences of the subjects.
- Second, the objective fit opinions of an expert judge are summarised to determine requirements that could improve the fit of the combat trousers.

4.5.1 Subjective fit preferences

In order to gain insight regarding the subjective fit preferences of the subjects, the most frequently expressed suggestions and recommendations from the one-to-one interviews were analysed and are presented in Table 24. In Table 24, an indication is given regarding the problem area that could result in a particular comment. The comments are indicated with the corresponding subject number. The researcher edited the statements of the subjects in order to clarify the meanings.

TABLE 24: FIT PREFERENCES OF THE SUBJECTS

Problem area	no.	Fit expectation
Waist	8	"Want a thicker belt."
	14	"The waistband should be bigger."
	24	"The loops must be thicker." "We mustn't tighten the waist with a belt, maybe we could have elastic on the sides."
	42	"The waistband must be a little higher so that even if I take out my belt, it still fits me." "The waistband must go a little up at the back...must take it a little bit higher."
Hips	5	"On the hips must have more shape (straight), it's seemingly for curves."
Thighs	43	"It starts to rub here (<i>inner thighs</i>) and you get a rash. Maybe they can give us cycle pants."
	23	"There should be something between the thighs. It mustn't tear."
Crotch	5	"This curve (<i>crotch</i>) must be made smaller, the front one."
Knees	1	"This portions of the knee (<i>knee guard</i>), it should be here so that it can be straight to my knee, so that when I kneel down I should be using it."
Leg length	24	"Must work on the length of the legs."
Fastener	6	"Put in a zip, sometimes the buttons get lost in the bush."
Balance	27	"Have two pockets. This pocket becomes big with all the pocket books, it doesn't look nice."
Fit preference	8	"If they can bring that old trouser back, I'll wear it."
	14	"Prefer to wear regular fit denim."

The comments in Table 24 reveal the following fit problems:

- The trouser waists are too large for some of the subjects, therefore the subjects suggested stronger waist support in the form of thicker belt loops, broader waistbands and elastic on the sides of the waistbands.

- The trouser hips are too wide on the sides, therefore, the subjects suggested straighter side hip shapes.
- The inner thighs of the trouser are too tight, therefore, the subjects suggested additional lining at the inner thigh areas, or permission to wear cycle shorts to prevent chafing.
- The front crotch appears too deep, therefore the subjects suggested a shorter front crotch curve.
- The knee guards are below the intended knee position, therefore, the subjects recommended that the knee guards be positioned higher.
- Even though certain subjects had been issued with the correct size, the trouser legs were too long for some of the subjects. Certain subjects therefore suggested shorter trouser leg lengths.
- The fly front button's closure is possibly not secure enough for combat training, therefore the subjects recommended a zip instead of buttons for the fly front.
- For the purpose of improved aesthetic appeal, the subjects suggested having two instead of one side pocket on the legs.
- The trousers have a bulky appearance, therefore, the subjects stated their preference for trousers with a standard fit, or the return to the older version of the combat trousers which also had a standard fit.

To conclude, the fit preferences of the subjects indicate the following:

- The combat trouser design does not fit the waist, hip, inner thigh and front crotch areas in a satisfactory manner.
- The combat trousers are aesthetically unappealing due to large side hips, deep crotch depths, low knee guards, long trunks, and pockets that are not balanced.
- The subjects prefer standard fit and not loose fitting trousers.

For protective garments, it is difficult to achieve a design that is attractive and comfortable while at rest (Watkins 1984:169). The same author mentions that stretch

inserts, slits, pleats, tucks, or other retractable design features may be used to preserve an attractive appearance at rest and also during movement.

The objective comments of an expert fit judge are presented in the following section.

4.5.2 Objective figure and fit analysis

To confirm the findings of this study, the comments of an expert fit judge are analysed. An expert fit judge (de Klerk 2006:1-7) from the University of Pretoria made notes based on the somatographs of the lower torso of the second phase sample. These notes support the findings of the study regarding the typical body shapes of the sample. De Klerk (2006:4) describes the second phase sample as follows:

- Small hips
- High protruding buttocks.
- Swaybacks
- Prominent stomachs
- Large front thighs.

Furthermore, de Klerk (2006:6) identified typical fit problems from the front, side and back views of the photographs of the subjects. The following fit problems were identified:

- The back crotch length pulls up tightly appearing too short for the subjects.
- The trousers are tight around the buttocks.
- The trouser front waists drop down, pushing the front crotch lower so that it appears too deep.
- In most instances, the combat trousers were too tight in the front thighs.
- The side seams pull across to the back, possibly due to back crotch seams that are too short and narrowness across the buttocks.

Against the figure and fit analysis, de Klerk (2006:7) recommended the following changes in order to achieve better fit:

- Increasing the length of the back crotch curve.
- Deepening the curve of the back crotch seam.
- Increasing the buttock width of the trousers.
- Decreasing the length of the front crotch curve.
- Inserting two darts in front instead of pleats and adding two pleats in the back instead of darts.

The comments of the fit expert confirm the body shapes of the subjects in terms of the baywindows, high protruding buttocks, forward hip stances and large front thighs. The fit problems identified by the fit expert confirm the findings of the general fit complaints and fit judging sessions in terms of the low fitted waist, deep crotch areas and tightness in the thigh area. The recommendations of the fit expert confirm the recommendations of Schofield *et al.* (2006:150,151) for alterations to the crotch.

To conclude, when comparing the subjective fit preferences of subjects to the objective fit analysis of the fit expert, the following can be inferred:

- The design of the combat trousers needs to be adjusted for the typical body shapes of the wearer.
- The design of the combat trousers must be comfortable for the wearer in the waist, hip, crotch, thigh and leg length.
- The combat trousers need to have a neat aesthetic appearance.
- The preferences of the subjects for trousers with a standard fit need to be accommodated.

In the following section, the findings of objective one, two and three are summarised and discussed in terms of the relevant literature.

4.6 SUMMARY AND DISCUSSION OF FINDINGS

In this section, the findings for each of the objectives are summarised and discussed. Recommendations are supported with relevant literature.

4.6.1 Findings and recommendations: objective one

With regard to the first objective, the nature of the fit complaints had to be determined and interpreted in terms of wearer characteristics and activities related to aesthetic appearance and functional aspects. The findings are summarised in terms of the general fit complaints regarding the aesthetic appearance and functionality of the combat trousers. The findings are analysed with the wearer characteristics in mind and thereafter recommendations are made.

- **General fit complaints** The findings indicate that subjects had fit complaints with regard to bulkiness in the hip areas, large/low waists, trouser legs that are too long, deep crotches and tight or bulky thigh areas. The majority of the complaints came from extra short subjects, of normal weight with forward hip stances.
- **Fit problems in terms of aesthetic appearance** The objective comments of the trained fit judges suggested that subjects preferred wearing the waist of the combat trousers lower than intended, which aggravated the problems with the aesthetic appearance of the trousers. This resulted in deep crotch lengths that restricted thigh movement of the subjects. The subjects that experienced the most problems with the aesthetic appearance of the combat trousers had forward hip stances, high protruding buttocks and large front thighs.
- **Fit problems in terms of functionality** The evaluation by the judges during the mobility tests indicated that kneeling and squatting resulted in the subjects' discomfort, restricted movement, and wearing the trouser waist lower than intended aggravated the problem. The majority of the subjects therefore

experienced discomfort and restriction of movement in the form of tightness in the thighs as a result of deep crotches. The subjects that experienced the most problems with kneeling and squatting were of average height or taller, average to overweight, with backward hip stances or balanced body shapes.

From the findings of the first objective, it is clear that the problems the subjects experienced with the fit of their combat trousers are the result of the fact that the combat trousers do not accommodate their typical body characteristics and because of the habit of these subjects to wear the trouser waists lower than intended. These problems point to an inadequate sizing system that does not accurately represent the body shapes of all the subjects. Recommendations are therefore discussed in terms of developing a more representative sizing system.

- **A representative sizing system** As a starting point to address the fit problems, the development of a new sizing system that is representative of the typical wearer characteristics of the SANDF male population, is recommended. To determine whether there is a need to consider age, ethnicity and work activities in the sizing system, it is recommended to simultaneously conduct a biographical study of the soldiers.

To be able to develop a new sizing system, an anthropometric survey should be conducted. This is in line with the opinion of other specialists in the sizing and fit field that a sizing system should be developed from a current and representative anthropometric survey (Green 1981:16, Beazley 1998:261). A sizing system is based on selected key body dimensions that anticipate the body shape of the wearer and therefore provide the size categories that need to be accommodated (Green 1981:16, Winks 1997:5, Beazley 1998:261, Petrova in Ashdown 2007:59).

- **Key body dimensions** It is recommended that the following body measurements be considered to base a new sizing chart on: natural waist, preferred waist, seat at fullest part of the buttocks, buttock width, thigh, front crotch, back crotch, total crotch, rise and inside leg length.

Strydom (2006:251) stresses the importance of considering measurements of curved body areas to ensure a better fitting garment. These measurements determine the shape of the wearer, and therefore assist in the development of a more functionally correct pattern design. Capturing the crotch measurements of the subjects is therefore very important in order to establish the required shape of the trouser crotch in terms of the body shapes of the subjects.

The above recommendation is in line with the opinion of Simmons and Istook (2003:308), namely that the critical body measurements applicable to the design of trousers should include the following: waist by natural indentation/waist by navel circumference, hip/seat circumference, inseam, outseam, rise, crotch length and thigh circumference. Body rise, also termed as rise height, is very important in order to distribute the crotch length and subsequently determine the curve of the crotch seam. Furthermore the correct shape of the crotch seam is critical for the fit of trousers (Simmons & Istook 2003:308).

- **3D body scanning technology** It is recommended that body dimensions be captured with the aid of three dimensional (3D) body scanning technology to scan the bodies of a large, representative sample of the male SANDF population. The use of 3D body scanning technology is more efficient than traditional methods of collecting body measurements as it is time saving, cost-effective, non-contact and the data collected can be retrieved with ease at any time (Daanen & van de Water 1998:111; Bye, LaBat & DeLong 2006:73; Connell, Ulrich, Brannon, Alexander & Presley 2006:80; Griffey & Ashdown 2006:112,113).

In the following section, the findings of the second objective are discussed in terms of the current design of the combat trousers and recommendations for future design.

4.6.2 Findings and recommendations: objective two

In line with the second objective, the design of the combat trousers needed to be analysed in terms of size, key dimensions, ease and proportion in order in order to determine the source of the fit problems.

The findings are summarised in terms of size problems, provision of ease and pattern design. Recommendations are discussed in terms of the aspects of dress (size and design).

- **Incorrect sizes** The findings indicate that incorrect sizes is one of the causes of the poor fit of the combat trousers for the following reasons: the subjects' lack of understanding of the sizing system, lack of stock and incorrect size labels. In addition, certain subjects chose larger trouser sizes to accommodate their larger thighs. The analysis of the waist, as presumably the only key dimension, indicates that the majority of the subjects received incorrect trouser sizes. Even the subjects that received the correct trouser sizes had other fit complaints. Therefore, the waist as the only key dimension is insufficient to determine the correct trouser size intended for a particular subject.

The above findings indicate the need for a size designation system that is understandable to the subject in which the appropriate key body dimensions are included to predict the body shape of the wearer. In addition, a reliable method for distribution of sizes is required. Improvement of quality control would prove beneficial in preventing incorrect size labels and the incorrect distribution of sizes to various military bases. However, quality control is not the focus of the study and will not be further discussed. Recommendations are therefore discussed in terms of a sizing system based on

appropriate key dimensions and accurately captured body measurements to facilitate the selection of correct sizes.

- **Provision of an appropriate size labelling system** It is recommended that size labelling describes the key dimensions for an intended size. The recommended key dimensions for size labelling should include the preferred waist, seat, crotch height and inside leg length measurements.

Workman and Lentz (2000:252), among many authors, state that a minimum of two body dimensions are required for garment sizing, of which one dimension is a horizontal measurement and the other, a vertical measurement. Currently, the height, seat and waist dimensions are used as key dimensions for sizing of the combat trousers. Height and seat are categorised as 5 for regular and 9 for tall/large. The measurements of the height and seat body dimensions are inconclusive and therefore confusing to the wearer.

In addition to the above, Chun-Yoon and Jasper (1996:93) found in their study regarding consumer size labelling systems, that vertical key dimensions such as height or length should be provided. Their study indicates that the inclusion of crotch height ensures better fit for pants.

Winks (1997:5) states that height is not necessarily proportional to the inside leg length dimension. Therefore, height is not truly representative of the intended leg length of trousers. Furthermore, it was found from the demographics that the majority of the subjects had short rises indicating proportionately longer leg lengths. It is therefore recommended that inside leg length be used instead of height, for sizing of trousers.

- **Size distribution** To provide an accurate means of size distribution, it is recommended that body measurements provided by 3D body scanner data be applied to accurately predict the most suitable sizes for the intended subjects. In

addition, it is recommended that the key dimensions be clearly defined before capturing, to ensure reliable size prediction. This is in agreement with Davis, Staples and Pargas (1998:18) who recommend the use of 3D scanner technology to capture the dimensions intended for size allocation.

- **Design** The analysis of the patterns of the combat trousers indicated that the design of the combat trousers does not accommodate the typical body shapes of the subjects in this study. The curved side hip area, low back crotch curve and more than standard ease from the waist to the thighs does not suit the subjects with baywindows, high protruding buttocks, forward hip stances and short body rises. In addition, the high waist of the combat trouser design is not in accordance with the preference of the subjects to wear their trouser waists lower than intended.
- **Design alterations** It is therefore clear that the design of the combat trouser basic pattern blocks is one of the causes of the fit problems. It is recommended that the design of the trouser pattern blocks be altered, to accommodate the typical body shapes of the majority of the population. Connell *et al.* (2006:82) state that not all persons who wear a specific size can be assumed to be of the same shape. The same authors state that individuals who range from small to large or short to tall within one apparel size category may have similar or different body shapes.

In the instance of this study, it was found that subjects with the following body shapes namely baywindows, high protruding buttocks and forward hip stances, have special needs regarding the design of their trousers. In addition, it was found that the majority of the subjects also have large front and inner thighs as well as short body rises. However, Rasband and Liechty (2006:64) state that when extensive, multiple alterations are required to accommodate the body shape, the garment would probably never fit properly. Recommendations are therefore discussed in terms of accommodating the

majority of the body shapes by focusing only on the swayback and typical shapes of Black soldiers.

- **The swayback** Multiple pattern alterations to the basic blocks can be avoided when reviewing the description of the forward hip stance. The forward hip stance causes the abdomen and hip to be thrown forward, resulting in a swayback (Vogue 1975:416). The swayback is characterised by a forward pelvic tilt, resulting in high protruding buttocks, indented groin, shorter front rise and larger back rise (Rasband & Liechty 2006:336). Therefore, by accommodating the swayback, an improved pattern design can be achieved. Liechty *et al.* (1992:166) provide alterations to accommodate the swayback as follows:

- The increased profile depth of the subject's buttocks requires a wider crotch extension in the form of a wedge, starting on the crotch seam on the hipline level and tapering to the side seam on the level of the crotch height (the hipline measured across the fullest part of the buttocks).
- When the variation is extreme, length may be added below the hip line (in the form of a wedge from the inseam at the crotch point, tapering in toward the knee line on the inseam).
- The adjustment in length and width relaxes and smoothes the fabric. The hip fitting line becomes level.

- **Typical body shapes of Black male SANDF soldiers** Considering that body shapes differ among various ethnic groups, it could be beneficial to alter the combat trouser pattern blocks to accommodate the typical body shapes of the Black male SANDF soldiers, as they comprise the majority of the group. A study by Giddings and Boles (1990:27) found that Black males aged between 18 to 30 years experience more fit problems with pants than their White counterparts. The study found that the fit problems that Black male subjects experienced included strain over the thighs and buttocks. The subjects of this study had similar

problems with the fit of the combat trousers.

Furthermore, Giddings and Boles (1990:28) found that there is a significant difference in body shape between the Black and White male bodies, namely, the Black male subjects had fuller, higher buttocks, fuller front thighs and a shorter sitting height compared to their White counterparts. This again proved true for the subjects in this study. Giddings and Boles (1990:28) stress the importance of developing garments focused on specific ethnic groups.

Subjects of this study had the same body shapes and similar fit problems to that of the study of Giddings and Boles (1990:28). Therefore, it is recommended that the pattern alterations by Giddings and Boles (1990:27) to accommodate Black males, be considered for Black male soldiers. Giddings and Boles (1990:27) designed a sample garment to accommodate the ethnic body variations differences of their sample. They made the following alterations (to a size 30 commercial pattern) to relieve strain in the buttocks and thigh area:

- 35mm was added to the width of the pants' front for ease in the thigh area.
- A wedge 61mm wide by 300mm long was added to the inseam at the crotch to allow the inseam to fall over the ankle.
- 13mm was added to the width of the pants' back for ease in the thigh and buttocks area.
- 48mm was added to the length of the hip area in the pants' back above the crotch line to provide ease and accommodate prominent buttocks.
- 13mm was removed from the side seam at the hip area to remove excess fabric.
- 57mm was removed from the back waist for a snug fit.
- 29mm was added to the top of the front waistline seam to make the waist line parallel to the floor.
- The back waistline dart was moved 42mm nearer to the centre back seam to accommodate prominent buttocks.

In the following section, the findings of the third objective are discussed in terms of subjective fit preferences and expert fit judging.

4.6.3 Findings and recommendations: objective three

The third objective stated that the fit of the combat trousers needed to be analysed and interpreted against the subjective fit preferences of the wearers and objective fit opinions of a fit expert.

The findings are summarised in terms of the fit preferences of the subjects and the comments of the fit expert.

- **Fit preferences of subjects** The subjects expressed a preference for trousers that are of standard fit, though the combat trousers they wore appeared to be loose fitting. The subjects stated that they preferred trousers that conform to the shape of their bodies, as the design of the combat trousers provided a sloppy appearance such as that of a 'tsotsi' (gangster).
- **Fit expert opinions** The comments of the fit expert confirmed the need to accommodate the typical body shapes of the subjects. The fact that the combat trousers did not conform to the body shapes of the subjects caused the fit problems that resulted in a poor aesthetic appearance. In addition, the fit expert agreed that the preference of the subject to wear the waist of the trousers lower than intended, has an impact on the fit and appearance of the combat trousers.

The findings of objective three highlight the importance of adapting the design of the combat trousers to fit the body shapes of the wearers. It is clear that the comments of the subjects and fit expert are important in identifying areas and causes of poor fit. Therefore, recommendations are further discussed in terms of developing test garments,

fit and wear testing the adapted designs, and fit judging from both the subject and expert viewpoints.

- **Fit and wear testing** Once a new sizing chart is developed and the basic trouser blocks are adapted to accommodate the typical body shapes of the majority of the population, it is recommended that test garments be developed for the purpose of fit and wear testing. In order to attain valid results, it is recommended that the fit models used for testing have body shapes and sizes representative of the majority of the male soldiers. In addition, it is recommended that fit and wear testing take place under the same circumstances in which the garment is worn, for example combat training under various climatic conditions.

Fit testing entails verifying that the garment designed for a specific size does indeed fit the dimensional specifications determined by the sizing system (Fan *et al.* 2004:33). Salusso-Deonier (1989:375) states that to be accurate, fitting models must be representative of the target population.

Fit testing procedures for the military include task simulations to test the clothing in active positions (McConville in Ashdown 2007:139). A basic motor test technique conducted by military standards evaluates whether or not a style allows sufficient amounts of ease during mobility (Watkins 1984:179). Kochar (1996:23) emphasizes the importance of dynamic fit (fit during actual use) of a garment, as it allows the wearer to stretch and bend, which is directly related to the safety of the wearer.

- **Fit judging** Fit and wear testing go hand in hand with fit judging. It is recommended that the subjective viewpoints of the wearers (fit models) and the objective viewpoints of the fit experts/trained fit judges are considered.

Ashdown and DeLong (1995:48), Shofield *et al.* (2006:152,153), and Ashdown and O'Connell (2006:139) state the importance of considering both the wearer and expert viewpoints with regard to judging garment fit. It is important to take into account the wearer's perceptions of fit because the wearer experiences and judges the fit based on both visual and tactical information. The expert judges the fit based only on visual indications such as seam placement and the location and orientation of wrinkles (Ashdown & DeLong 1995:48).

In their study, Ashdown and Dunne (2006:129) asked subjects to verbally express their desired fit preference and suggested alterations to the design of the test garments. Alexander (2005:57) designed a questionnaire to determine the fit preferences of young female subjects. In this questionnaire, fit preferences included choice of fit in terms of fitted, semi-fitted and loosely fitted, at the various body locations.

In conclusion, the recommendations for this study could serve to accommodate an optimum number of male members of the SANDF with combat trousers that fit well.

In the following chapter, the conclusions of the study and recommendations for future studies in the sizing and fit field follow.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The contents of this chapter are presented in the following order:

- An overview of the study.
- The conclusions of the study in terms of the objectives.
- Recommendations for future soldiers
- Closing words.

5.2 OVERVIEW OF THE STUDY

An overview of the study is presented in terms of the goals, objectives, conceptual framework, methods, soundness and limitations of the study.

5.2.1 Goals and objectives

The goals of the study were to investigate problems experienced by the male military members of the SANDF with the fit of the male combat trousers, especially in the crotch area, and to make recommendations regarding possible solutions for the fit problems.

The objectives of this study were: first, to determine the nature of the fit complaints and to interpret these complaints in terms of wearer characteristics and activities related to aesthetic and functional aspects; second, to analyse the design of the combat trousers in terms of size, key dimensions, proportion, balance and ease to determine the source of the fit problems; and third, to analyse the fit of the combat trousers and interpret the findings against the subjective fit preferences of the wearers, and objective fit opinions of the experts.

5.2.2 Conceptual framework

In order to fully achieve the goals and objectives of the study, it was necessary to conduct a relevant literature study with the help of a conceptual framework that was developed on the aspects of body and dress from Hillestad's Taxonomy (1980:120). The conceptual framework served as an ordering structure for the literature review and for the development of an operational map which ensured all relevant topics were covered for each method.

The literature study assisted in the development of methods for the data collection process. From the conceptual framework an operational map (ANNEXURE A) was developed to ensure that all relevant topics were covered during the data collection process. The conceptual framework also served as a ordering structure for the discussion of the findings.

5.2.3 Methods

In order to achieve the objectives of the study it was necessary to apply a multi-method approach that ensured triangulation for this qualitative research project. According to Denzin in De Vos (2002: 341) a multi-method approach ensures triangulation for a qualitative study and therefore enhances its soundness. The data collection methods that were used included: biographic profiling, focus group interviews, one-to-one interviews, fit judging, motor testing, photographs, somatographs, body measuring, garment measuring and pattern analysis.

Biographic profiling assisted in describing the demographics of the second phase sample in terms of two age groups, namely 25 to 35 and 36 to 44 years. This further assisted in categorising the wearer characteristics of the second phase sample in terms of the two age groups.

Interviewing assisted in exploring and describing the subjects' viewpoints regarding the fit of the combat trousers. Subjects were classified into two categories according to the interviews, namely a first phase sample consisting of the subjects who participated in the focus groups and a second phase sample selected from the first sample. These subjects participated in the one-to-one interviews and in the remainder of the study. Focus group interviews assisted in attaining an overall viewpoint of the subjects in terms of general fit complaints, complaints in terms of aesthetic appearance, complaints related to sizing and fit preferences of the subjects. Similarly, one-to-one interviews assisted in attaining an in-depth perspective from each subject in the second phase sample.

The fit judgment was conducted by two trained fit judges and assisted in the identification of fit problems in relation to aesthetic appearance for the second phase sample. The fit judging conducted by the fit expert, assisted in identifying fit problems and providing recommendations for improving the fit of the combat trousers for the subjects' various body shapes.

The motor tests provided valid information regarding the functionality of the combat trousers. With the aid of the mobility tests, it was possible to establish functional problems of the combat trousers and to identify areas where problems with ease were experienced.

The fit expert used the photographs of the subjects in their combat trousers to judge the fit of the combat trousers. In addition, the photographs served as memo trails to endorse validation of the results of the fit judging.

The somatographs were used to describe the subjects of the second phase sample in terms of body shape. The body shape categories assisted in the identification of subjects who expressed general fit complaints and movement difficulties.

Body measurement was used to determine wearer characteristics and to establish which subjects expressed certain problems. The weight and height of the subjects was applied to calculate the BMI values of the subjects. The height and BMI categories assisted in the identification of subjects who expressed general fit complaints and movement difficulties. In addition, body measuring assisted in calculating the provision of ease for the combat trousers.

Garment measuring was also intended to calculate the provision of ease. The sample garments that were measured, however, did not follow the specifications of ARMSCOR (RSA-MIL-SPEC 220. 2001:11) and were therefore not used for the study. Instead, the pattern dimensions and ARMSCOR (RSA-MIL-SPEC 220. 2001:11) specifications were used for the purpose of calculating ease.

Pattern comparisons assisted in establishing if the proportions of the pattern contributed to the fit problems of the combat trousers. This further assisted in identifying fit problems related to the body shapes of the subjects in terms of the shape of the pattern, particularly in the crotch and hip areas.

5.2.4 Soundness of the study

Lincon and Guba in De Vos (2002:351) refer to soundness of a study as the credibility, transferability, dependability and confirmability that reflect the qualitative paradigm. Even though it was not possible to control all the factors (due to aspects such as logistical problems and incorrect sample garments), as many measures as possible were employed to ensure the trustworthiness of the study such as triangulation, extensive field notes, member checks, audit trails, etc.

With regard to credibility, the method used to identify and describe the subjects was accurate. Various methods were used to explore and describe the fit problems. To ensure that reliable information was gathered during the interviews, member checks

were conducted. In addition, audit trails were kept including field notes, audiotapes, written reports and official company documents. To ensure that the trained fit judges did not provide subjective opinions during fit testing, a fit guide was developed and followed.

With regard to transferability, the researcher continuously referred back to the established conceptual framework and relevant concepts of the study to guide the researcher through the entire study. In addition, the operational map was followed to ensure that all aspects related to fit were explored and described.

The research site facilitated dependability as it provided an ideal working environment for the research team. Two separate, yet proximate facilities were used for different phases of the study. An auditorium was used for the focus groups and one-to-one interviews, providing privacy, clarity of sound and no external disturbances. A large vacant office area with dress room facilities was used for the other testing methods, providing privacy for subjects changing and adequate lighting for the photographs to be taken.

With regard to confirmability, the findings of this study were compared to the findings of related studies on fit, sizing, consumer preferences and relevant literature. With the aid of photographs and somatographs, the researcher was able to confirm findings of the fit judging.

5.2.5 Limitations of the study

The limitations of the study are discussed in terms of the sample and methods that were used to obtain the results.

The sample was small because a qualitative research strategy was selected. The study was not limited by the size, but rather in terms of whether the sample is representative of the male SANDF population, in terms of age and ethnicity. The focus age group for the African Warrior Project was 18 to 35 years. The researcher did not have a choice in selection of the sample and was therefore allocated with subjects that were older than the focus age group. The researcher also did not have a choice in selecting a more ethnically diverse sample. Of the 60 subjects that participated in the study, all were Black with the exception of one Coloured subject. There were subsequently no White and Asian subjects who participated in the study.

For the second phase sample, the majority of the subjects were wearing the incorrect trouser size according to the waist dimension. Size distribution proved to be a problem. It would have been preferable to collect data with all the subjects wearing correct trouser sizes. It is possible that the findings of the study would have differed if all the subjects were wearing correct trouser sizes.

Due to logistic problems only one military base, 10SAI (South African Infantry), was visited during November 2006 to collect data. It cannot be said for certain that the findings of this study are representative of the other military bases in South Africa.

With regard to the one-to-one interviews, it would have been preferable to revisit the second phase samples for further in-depth interviewing. The future location of the subjects could however not be guaranteed as they were regularly assigned to different bases. The researcher was therefore provided with only one opportunity to explore and clarify the comments of each subject.

With regard to fit judging, the fit checklist was lengthy and therefore, tedious to complete and analyse. This did however ensure that the researcher could investigate all the elements of fit to identify fit problems with the combat trousers.

With regard to the mobility tests, the subjects pulled up their combat trousers at the waists before performing the movements. To achieve more accurate results regarding movement restriction, it would have been preferable that the subjects did not pull up the waist of their combat trousers. The fact that the subjects pulled up their trouser waists, did however identify a critical problem namely movement restriction.

Ease had to be calculated from patterns and specifications instead of being calculated from the garment measurements. With regard to garment measuring, it was found that the sample garments that were measured did not comply with the ARMSCOR specification (RSA-MIL-SPEC 220. 2001:11), and therefore could not be used for this study. It would have been ideal to measure the combat trousers worn by the subjects. Due to time constraints, subjects could not be revisited for garment measuring, therefore sample garments were measured instead.

Finally, without the aid of 3D body scanning technology, the researcher was unable to conduct a comprehensive study of the body shapes, postures and dimensions of the subjects. The data produced by 3D body scanning technology could save time with body measuring, somatographs and photographs.

Against the limitations of the study, the conclusions of the findings are presented in the following section.

5.3 CONCLUSIONS OF THE STUDY

In this section, the conclusive findings of each objective are presented.

5.3.1 Conclusions of objective one

For the first objective, the nature of the fit complaints was determined and interpreted in terms of wearer characteristics and activities related to aesthetics and functional aspect.

From the demographic description of the sample, it can be concluded that the majority of the subjects in the second sample were short and overweight with baywindows, high protruding buttocks and forward hip stances. The subjects had the most general fit problems with the bulkiness in the hip areas, large/low waists, trouser legs that were too long and crotch areas that were too deep. Fit problems are also related to the fact that subjects preferred to wear their trousers lower on their waists. The poor fit of the combat trousers results in an overall poor aesthetic appearance. The findings from the subjective opinions of the subjects, as well as the objective evaluation of the judges during the mobility tests, confirm that the combat trousers have an effect on the movement ability of the subjects. The findings of the first objective indicate a two-fold problem: the nature of the wearer characteristics and the design of the combat trousers. In conclusion, the findings point to the possibility of a problematic garment design in relation to the specific wearer characteristics of the subjects.

5.3.2 Conclusions of objective two

For the second objective, the design of the combat trousers was analysed in terms of the waist key dimension, proportion, balance and ease to determine the source of the fit problems.

The findings of the second objective indicate five salient problems. First, problems with size knowledge, sizing, size distribution, size allocation and quality control caused subjects to receive the wrong trouser sizes. The proportion of the waist and thigh of the combat trousers design forced the subjects to choose the wrong size to accommodate the thighs. Second, the waist as a key dimension is not sufficient to ensure that subjects receive the correct trouser size. Third, the waist as the only key body dimension does not ensure adequate ease at other body locations such as seat and thigh. Fourth, from the subjective and objective viewpoints regarding fit, and analysis of ease and patterns, it is clear that ease is provided in the incorrect areas resulting in tightness in the thighs, deep

crotch depths and overly baggy leg trunks. The fit of the combat trousers is diversely affected by the position in which the trousers are worn.

5.3.3 Conclusions of objective three

For the third objective, the fit of the combat trousers was analysed and the findings were interpreted against the subjective fit preferences of the wearer, and objective fit opinions of a fit expert.

The findings of objective three indicate that the design of the combat trousers needs to accommodate the fit preferences of the subjects to produce a design that is both functional and aesthetically appealing. The comments of the fit expert further emphasise the need to adjust the design of the combat trousers to accommodate the typical body shapes of the subjects.

It is therefore recommended that the design of the combat trousers receives attention. Altered or new designs should be fit and wear tested.

5.4 RECOMMENDATIONS FOR FUTURE STUDIES

It is recommended that a comprehensive study, of a similar nature, be conducted to develop better fitting garments in the following order:

- Conduct a comprehensive anthropometric study using 3D scanning technology, to acquire a current and representative body of data, in order to develop a current and representative sizing system.
- Identify possible market niche(s) e.g. in terms of body shapes.
- Develop sizing charts representative of the body sizes and shapes of the target population.
- Design test garments that accommodate the typical body shapes and fit preferences of the target population to ensure optimum functionality with the necessary aesthetic appeal for an optimum number of wearers.

- Perform fit and wear testing on test garments under controlled conditions similar to that under which the garments will eventually be worn.
 - * Train a panel of fit judges and statistically eliminate the candidates who do not perform according to set standards.
 - * Use fit models that represent the typical body characteristics of the target population.

5.5 CLOSING WORDS

Although the findings of this qualitative study cannot be generalised, its value lies in the multi-method approach to study the fit of garments. The findings of this study support the importance of considering the subjective opinions of the wearers regarding the fit of their garments.

Within the framework of the African Warrior Project, the findings of this study made an important contribution to improve the fit of the combat trousers. It provides a point of departure for a more comprehensive study to ensure better fit of military garments for an optimum number of soldiers.

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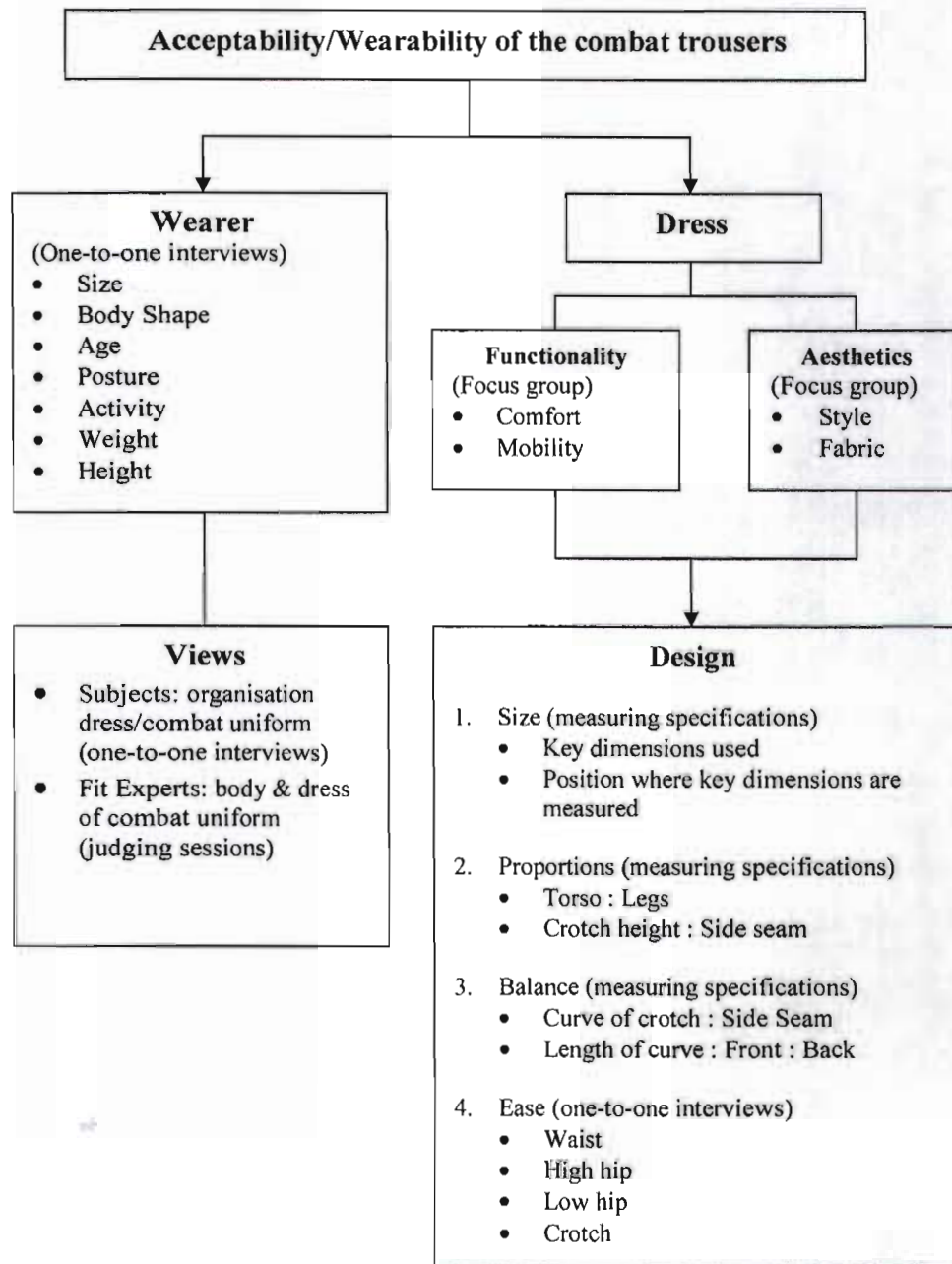
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ANNEXURE A: OPERATIONAL MAP



ANNEXURE B: QUESTIONS FOR FOCUS GROUPS

Introduction to subjects for focus groups

There have been problems reported regarding the fit of your combat trousers. I am here today to determine from you where these problem lies, what is causing them and who of you are satisfied or dissatisfied with the fit of their trousers. This focus group is done for your benefit so that you can be provided with better fitting combat trousers in the future. Therefore, please answer all questions honestly and do not hesitate to give your opinion during the discussion.

To start of with, I am going to draw three illustrations to help you get an idea of what good and bad fit looks like. This will help you determine your own combat trouser fit.

Illustration 1 shows a good fit. You can tell this by looking at the lines of the garment, they run smoothly down. Most importantly there are no wrinkles, sagging or folds. The garment fits comfortably on all parts of the body.

Illustration 2 shows a poor fit that is oversized. This is visible through folds and sagginess on all part of the garment for example the crotch is hanging too low and the waistline is folding around the belt.

Illustration 3 shows a poor fit that is too small. This is visible through wrinkles and pulling throughout the garment, for example, tightness around the thighs can cause wrinkles around the areas of tightness.

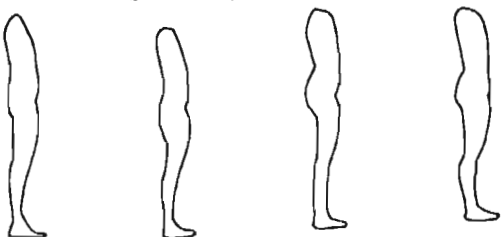
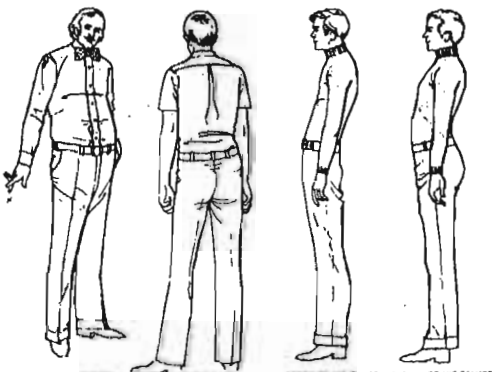
You will see that you can have a combination fit. For example, you could have a good fit but only the waist is too big or too small. I want to know from you what kind of fit do you think you have.

1. Let's start off with a vote. Who here feels that they are completely satisfied with the fit of their combat trousers?
2. Who here experiences some sort of fit problem with their combat trousers?
3. For those who are satisfied with their fit, what do you think it is that makes the combat trousers fit you well? (Probes: your body shape/size, the style of the garment, your age, job activities etc.)
4. For those who are dissatisfied with their fit, what do you think it is that makes the combat trousers not fit you well? (Probes: your body shape/size, the style of the garment, your age, job activities etc.)
5. If you are experiencing poor fit, how does this affect your physical comfort while you are working (Probe: movements such as running, jumping and stationary positions such as sitting and standing).
6. Think of your most comfortable pair of trousers, what style are they? (Probe: track suits, cargos, denims etc.)
7. Now tell me, what is it about your favourite trousers that make it comfortable? (Probe: style, fabric, fashionability etc).
8. What would you change about your combat trousers to make them more comfortable to be like your favourite pair of trousers?
9. Does the fit of your combat trousers affect your image in front of your colleagues or when you are in public? Please explain.

ANNEXURE C: QUESTIONS FOR ONE-TO-ONE INTERVIEWS

Introduction to subjects for one-to-one interviews

Some of you mentioned from the focus group that you were experiencing problems with the fit of your combat trousers. I would like to know more specifically, exactly what is affecting your combat trousers fit. I have a list to show you. The column on your left contains possible causes of poor fit due to your body shape. The other column contains possible causes of poor fit due to problems with the combat trousers and the location of the problem(s).

WEARER'S BODY	TROUSERS
<ul style="list-style-type: none"> • Body size (small/medium/large built) • Body Shape • Age • Posture (pelvic tilt)  <p>Slight moderate full moderate with tucked pelvis</p> <p>Body shapes</p>  <p>BAY WINDOW BULGING HIPS FORWARD HIP STANCE BACKWARD HIP STANCE</p> <ul style="list-style-type: none"> • Activity (office/physical training/other) • Weight (distribution, over/under) • Height (affect on clothing fit) 	<p>Functionality</p> <ul style="list-style-type: none"> • Comfort • Mobility <p>Aesthetics</p> <ul style="list-style-type: none"> • Style • Colour • Fabric <p>Design</p> <ol style="list-style-type: none"> 1. Size <ul style="list-style-type: none"> • Key dimensions • Position where key dimensions are measured 2. Proportions <ul style="list-style-type: none"> • Torso : Legs • Crotch height : Side seam 3. Balance <ul style="list-style-type: none"> • Curve of crotch : Side Seam • Length of curve : Front : Back 4. Tolerance (space for movement) <ul style="list-style-type: none"> • Waist • High hip • Low hip • Crotch

I would like to know from you, looking at the two columns what and where do you experience fit problems? (probe: body size/shape, garment size/shape).

1. I would like for you to explain to me why you do not experience this problem with your favourite pair of pants. (probe: fashionability, size, fit, style, comfort, etc.)
2. Where do you wear your trousers, on you hips or waist? Show me. Would it be uncomfortable for you to wear them on the natural waist? (only ask this if they wears the waist on their lower) (probe: natural waist, trousers waist, high hip, low hip)
3. Where do you wear your favourite pair of trousers? (probe: natural waist, trousers waist, high hip, low hip)
4. Does the armour belt affect the comfort of wearing your combat trousers? (probe: weight, size and placement of belt)
5. Do you wear all your trousers like this? (low, on or high on the waist) Why?
6. Are there any suggestions you would like to make regarding ways to solve the fit problems you are experiencing?

Note: questions for one-to-one interviews are not set due to individuals having differences in fit problems. The questions are asked using the key words from the operational map accordingly to each subject's problem(s).

ANNEXURE D: BIOGRAPHIC PROFILING

Date: _____ Session: _____
 Subject No: _____ Size of issued combat trouser: _____

You are requested to answer each question. Indicate your choice by marking the appropriate block with an X when asked for:

For example:

Male: ☒

Female: ☐

This questionnaire is completed anonymously and will take approximately a minute of your time. Thank you kindly for your co-operation.

		Office use only
1. Ethnic group:		
Black: <input type="checkbox"/>	Asian: <input type="checkbox"/>	
White: <input type="checkbox"/>	Coloured: <input type="checkbox"/>	
2. State your date of birth (year/month/day)		
/ /		
3. Which activities do you perform in your combat trousers:		
Office work	<input type="checkbox"/>	
Physical training	<input type="checkbox"/>	
Both	<input type="checkbox"/>	
Others (please write out):		

ANNEXURE E: FIT CHECKLIST

Date: _____ Session: _____
 Subject No: _____ Size of issued combat trouser: _____

The fit training manual must be used as a guide during judging when uncertainty arises. Please start with the letter allocated of the garment/body location when describing the problems e.g. c) lower hip has...

Grain – Is grain alignment correct? If not describe the impact on the body location(s).	
1) front view body locations a) waist b) high hip c) lower hip d) crotch area e) upper legs f) calves	Problem description: _____ _____ _____ _____ _____ _____ _____
2) side view body locations a) waist b) high hip c) lower hip d) crotch area e) upper legs f) calves	Problem description: _____ _____ _____ _____ _____ _____ _____
3) back view body locations a) waist b) buttocks c) crotch area d) upper legs e) calves	Problem description: _____ _____ _____ _____ _____ _____ _____
Set – Are there any wrinkles? If so, describe what type and the impact on the body location(s).	
1) front view body locations a) waist b) high hip c) lower hip d) crotch area e) upper legs f) calves	Problem description: _____ _____ _____ _____ _____ _____ _____

<u>2) side view</u> <u>body locations</u> a) waist b) high hip c) lower hip d) crotch area e) upper legs f) calves	Problem description:
<u>3) back view</u> <u>body locations</u> a) waist b) buttocks c) crotch area d) upper legs e) calves	Problem description:
Set – Are there any folds? If so describe them and the impact on the body location(s).	
<u>1) front view</u> <u>body locations</u> a) waist b) high hip c) lower hip d) crotch area e) upper legs f) calves	Problem description:
<u>2) side view</u> <u>body locations</u> a) waist b) high hip c) lower hip d) crotch area e) upper legs f) calves	Problem description:
<u>3) back view</u> <u>body locations</u> a) waist b) buttocks c) crotch area d) upper legs e) calves	Problem description:
Line – Are the lines of the garment correct aligned with the body? If not describe their impact on the body location(s).	
<u>Garment lines</u> 1) waist line 2) side seam 3) hem line 4) centre front 5) centre back 6) darts/pleats	Problem description:

Balance – Is the fabric distribution of the garment balanced? If not describe the impact on the body location(s).	
1) <u>front view</u> <u>body locations</u> a) waist b) high hip c) lower hip d) crotch area e) upper legs f) calves	Problem description:
2) <u>side view</u> <u>body locations</u> a) waist b) high hip c) lower hip d) crotch area e) upper legs f) calves	Problem description:
3) <u>back view</u> <u>body locations</u> a) waist b) buttocks c) crotch area d) upper legs e) calves	Problem description:
Ease – Is there bulging of fabric? If so describe the impact on the body location(s).	
<u>Body locations</u> 1) waist front 2) waist back 3) front hip 4) back hip 5) front crotch 6) back crotch 7) front legs 8) back legs	Problem description:
Ease – Is there stressing of fabric? If so describe the impact on the body location(s).	
<u>Body locations</u> 1) waist front 2) waist back 3) front hip 4) back hip 5) front crotch 6) back crotch 7) front legs 8) back legs	Problem description:

ANNEXURE F: MOTOR TEST

Date: _____ Session: _____
Subject No: _____ Size of issued
Judge: _____ combat trouser _____

Instruction to subject:

- 1) **Kneeling:** stand upright, kneel on left knee, then kneel on both knees, return to standing.

Comments:

Instruction to subject:

- 2) **Squats:** stand upright with feet shoulder width apart and squat down to a full knee bend and reach forward, return to standing.

Comments:

Instruction to subject:

- 3) **Body bends:** stand upright with arms at the side. Bend body to left and return, bend body forward and return, bend body right and return.

Comments:

Instruction to subject:

- 4) **Walking:** walk a distance of 10 meters.

Comments:

Instruction to subject:

- 5) **Crawling through confined space:** crawl on hands and knees over two meters.

Comments:

Instruction to subject:

- 6) **Sit on a chair and reach forward.**

Comments:

- 7) **Aesthetic impression.**

Comments:

- 8) **Professional/Corporate image.**

Comments:

- 9) **Additional comments:**

ANNEXURE G: PHOTOGRAPHS

Back view



Side view

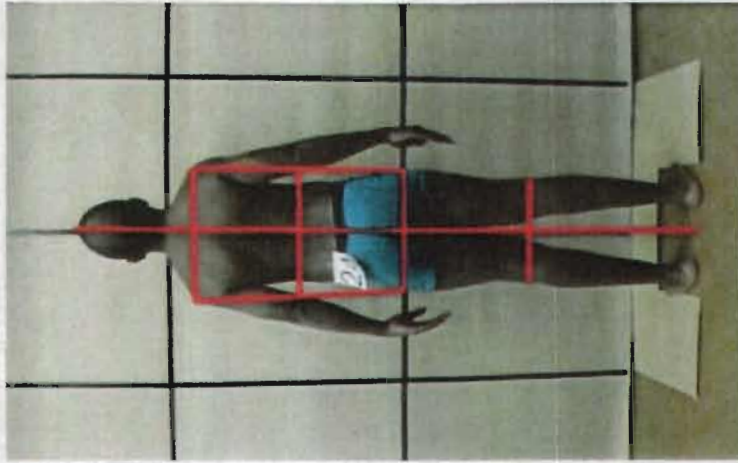


Front view

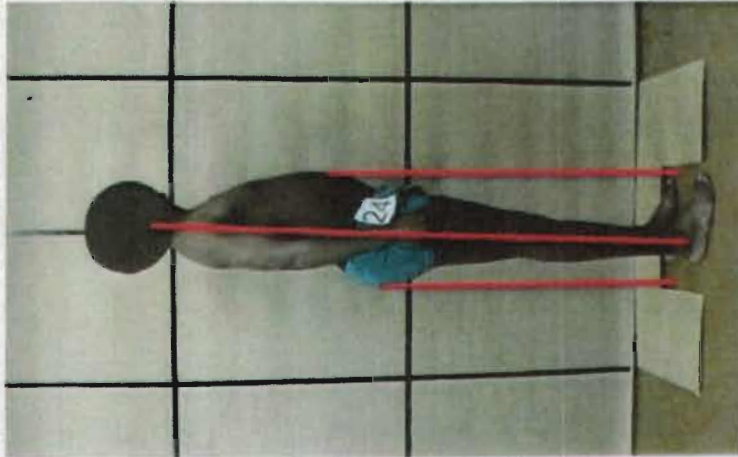


ANNEXURE H: SOMATOGRAPHS

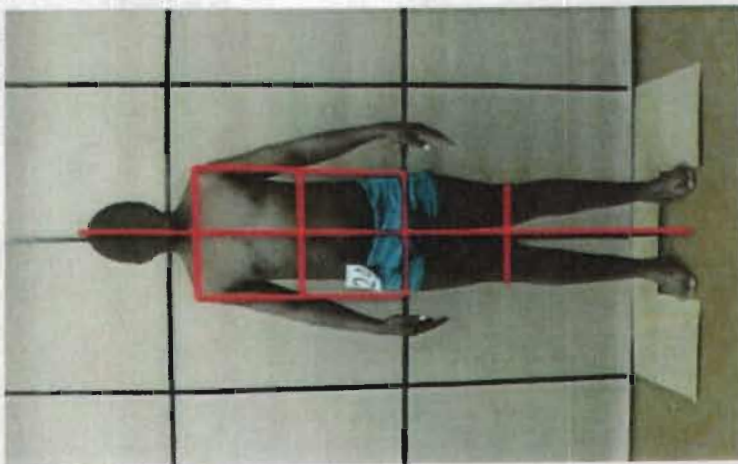
Back view



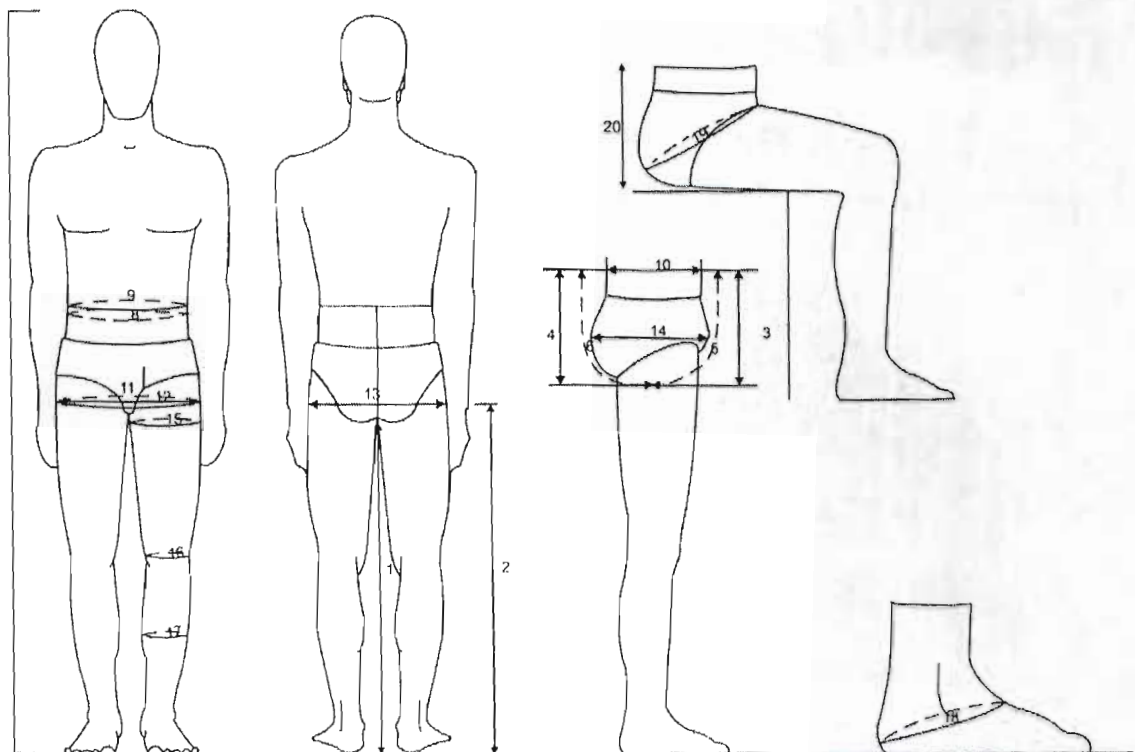
Side view



Front view



ANNEXURE I-1: BODY MEASUREMENTS



Body measuring definitions

Standing vertical dimensions	
Height/Stature:	"The vertical distance from a standing surface to the top of the head. The subject stands erect with the head in the Frankfort plane. The heels are together with the weight distributed equally on both feet. The shoulder and upper extremities are relaxed" (RMSS 1994:30).
Weight/Mass:	"The subject stands on the platform of a scale. Subject is weighed wearing undergarments only. The mass of the subject is taken to the nearest tenth of a kilogram" (RMSS 1994:29).
1. Inside leg length/Crotch height:	"The vertical distance between the standing surface and the crotch. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet" (RMSS 1994:76).
2. Outside leg length/Lower limb/Trochanterion height:	"The vertical distance between a standing surface and the trochanterion landmark on the upper side of the right thigh. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet" (RMS. 1994:77).
3. (Front) Body rise:	"The vertical distance, measured using the measuring stand (anthropometer) between the waist level and the crotch level (at the front)" (ISO 1989:5).
4. (Back) Body rise:	"The vertical distance, measured using the measuring stand (anthropometer) between the waist level and the crotch level (at the back)" (ISO 1989:5).
5. (Front) Crotch length:	"The distance, measured using the tape-measure, from the centre of the natural waist level at the front of the body, through to the crotch point" (ISO 1989:7).

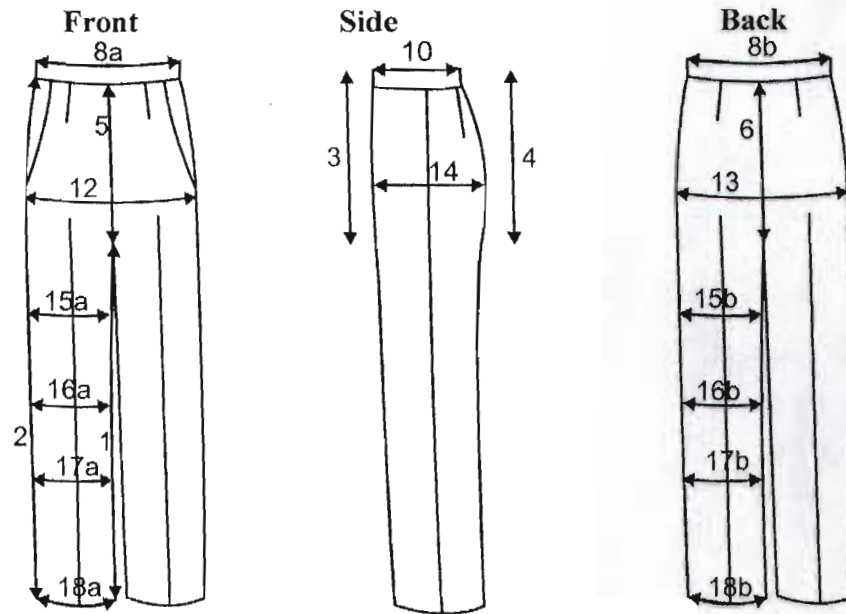
6. (Back) Crotch length: "The distance, measured using the tape-measure, from the centre of the natural waist level at the back of the body, through the crotch, to the crotch point" (ISO 1989:7).
7. Total crotch length/Lower trunk length: "The distance, measured using the tape-measure, from the centre of the natural waist level at the front of the body, through the crotch, to the centre of the back at the waist level" (ISO 1989:7).
Standing horizontal dimensions
8. Waist circumference: "The circumference at level of omphalion (belly button).
9. Natural waist: "The circumference at level of natural indentation" (RMSS 1994:196). The natural waist position can be identified there where a subject places their hands on their waist.
10. Waist depth: "The horizontal breadth of the waist at the level of omphalion. The subject stands erect looking straight ahead. The heels are together with the weight distributed equally on both feet. The measurement is taken at the maximum point of quiet respiration" (RMSS 1994:68).
11. Hip circumference (maximum): "The circumference at the point where the hips are the widest" (RMSS 1994:196).
12. (Front) Hip width: "Distance between the lateral point of the hips or thighs (whichever are broader). Subject stands erect and is measured from the front, the maximum distance of the hips" (RMSS 1994:69).
13. (Back) Hip width: "Distance between the lateral point of the hips or thighs (whichever are broader). Subject stands erect and is measured from the back, the maximum distance of the hips" (RMSS 1994:69).
14. Buttock depth: "The distance between the anterior and posterior maximum buttock point. The subject stands erect and is measured from the side" (RMSS 1994:72).
15. Thigh circumference: "Thigh circumference taken at the gluteal (buttock) crease" (RMSS 1994:178).
16. Knee circumference straight: "The circumference at midpatella (centre of the knee). The subject is standing erect with the body weight evenly distributed" (RMSS 1994:179).
17. Calf circumference: "The maximum horizontal circumference of the calf at the widest portion" (RMSS 1994:180).
18. Heel-ankle circumference: "The circumference of the right foot at the ankle and base of the heel is measured with a tape passing over the point at which the heel first contacts the surface and over the dorsal juncture of foot and leg landmark at the front of the ankle. The subject stands erect with the weight distributed evenly on both feet" (RMSS 1994:117).
Seated dimensions
19. Hip circumference: "The circumference at the point where the hips are the widest" (RMSS 1994:196). Taken while seated
20. Body rise: the vertical measurement taken from the seated point of the buttock to the subjects waist line (Aldrich 1997:10)

ANNEXURE I-2: SUBJECT MEASURING SPECIFICATIONS: DATA CAPTURING SHEET

Date: _____ Session: _____
 Subject No: _____ Size of issued combat trouser: _____
 Subject Height: _____ Subject weight: _____

Key dimensions	Subject's body measurements
Standing vertical dimensions (mm)	
1. Inside leg length	
2. Outside leg length	
3. Front rise	
4. Back rise	
5. Front crotch length	
6. Back crotch length	
7. Total crotch length	
Standing horizontal dimensions (mm)	
8. Waist circumference	
9. Natural waist	
10. Waist depth	
11. Hip circumference	
12. Front hip width	
13. Back hip width	
14. Buttock depth	
15. Thigh circumference	
16. Knee circumference straight	
17. Calf circumference	
18. Heel-ankle circumference	

ANNEXURE J-1: GARMENT MEASUREMENTS



Garment measuring definitions

Vertical dimensions	
1.	Inside leg length: The distance between the crotch point on the crotch line through to the bottom hem of the leg.
2.	Outside leg length: The distance between the waistline on the side seam through to the bottom hem of the leg on the side seam.
3.	Front rise: The vertical distance between the waistline and crotch line measured at the centre front.
4.	Back rise: The vertical distance between the waistline and crotch line measured at the centre back.
5.	Front crotch length: The distance between the waistline and the crotch point measured against the centre front seam line.
6.	Back crotch length: The distance between the waistline and the crotch point measured against the centre back seam line.
7.	Total crotch length: Front crotch length plus back crotch length (5 + 6).
Horizontal dimensions	
8.	Waist circumference: The circumference of the trousers waistline (8a+8b).
9.	Natural waist circumference: The circumference of the trousers where subject indicated waist line.
10.	Waist depth: The distance on the waistline measured from the centre front seam point through to the centre back seam point.
11.	Hip/Seat circumference: The hipline on the trousers, which corresponds to the fullest part of the hips on the body (12+13).
12.	Front hip width: The distance on the hip line from the right side seamline point to the left side seamline point at the trousers front.

13. Back hip width:	The distance on the hip line from the right side seamline point to the left side seamline point at the trousers back.
14. Buttock depth:	The distance on the hipline from the centre front seamline point to the centre back seamline point.
15. Thigh circumference:	The distance from the right trousers side seam point on the thigh seam to the inside legs seam point through to the side seam point again.
16. Knee circumference straight:	The distance from the right trousers side seam point on the knee seam to the inside legs seam point through to the side seam point again.
17. Calf circumference:	Midpoint between the knee seamline and the trousers hemline.
18. Bottom hem of leg:	Hemline on the trousers bottom.

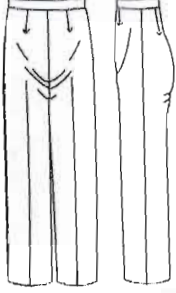


ANNEXURE J-2: GARMENT MEASURING SPECIFICATIONS: DATA CAPTURING SHEET




Date: _____ Session: _____
 Subject No: _____ Size of issued combat trouser: _____




Key dimensions	Combat trousers	ARMSCOR
Vertical dimensions (mm)		
1. Inside leg length		
2. Outside leg length		
3. Front rise		
4. Back rise		
5. Front crotch length		
6. Back crotch length		
7. Total crotch length		
Horizontal dimensions (mm)		
8. Waist circumference		
9. Natural waist		
10. Waist depth		
11. Hip/Seat circumference		
12. Front hip width		
13. Back hip width		
14. Buttock depth		
15. Thigh circumference		
16. Knee circumference straight		
17. Calf circumference		
18. Bottom hem of leg		
Seated dimensions (mm)		
19. Hip circumference		
20. Body rise		




ANNEXURE K: FIT JUDGING GUIDE

Liechty, Pottberg and Rasband (1992:126-191)

<p>1. Long crotch depth front and side view</p> 	<p>The fabric is loose above the hipline along the side seams and below the back dart tips because the fabric shaping is above the corresponding body contour. The fabric bows downward across the body centres because the fabric binds against the crotch. The trousers fabric either pulls into the crotch crevice or forms into diagonal wrinkles from the crotch to the hipbones and the buttocks. The hem positions may be too high.</p>
<p>2. Short crotch depth side view</p> 	<p>The fabric is snug at the hipline along the side seams and across the back darts because the body contour is above the corresponding fabric shaping. The buttocks may lift the fabric into horizontal folds across the centre back and the side seams to slant toward the back at the hem. The crotch seam is below the body level. This inhibits walking comfortably and causes strain on the stitching of the crotch seam. Folds may form just below the crotch.</p>
<p>3. Small waist front view</p> 	<p>Forcing the garment to close constricts the body at the waist and compresses the soft tissue. This compression causes body tissue to expand below and above the waist. The force lifts the fabric into horizontal folds around the waistline. The hip fitting line remains level. The strain could cause the fabric to pull into diagonal wrinkles from the crotch towards the hip bones. The hip fitting line pulls towards at the body centres. The taut fabric at the crotch causes discomfort.</p>

<p>4. Large waist front view</p> 	<p>The edges of the garment opening lap beyond the closure line. When fastened on the closure line, the waist, hip and hem lines of the garment drop below the corresponding positions of the body. As a result, the fabric near the side seams is loose. The hip fitting line remains level. The crotch seam is below the body surface. This inhibits walking comfortably and causes strain on the crotch seam.</p>
<p>5. Small hips front view</p> 	<p>The fabric along the side seams is loose at the fullest part of the hips. The hip fitting line and hemline positions are not affected.</p>
<p>6. Large hips front view</p> 	<p>The fabric pulls taut around the fullest part of the hips. A horizontal fold can form around the waist. The hip fitting line and hemline position both remain level. The fabric cannot rise at the centre front and centre back because it binds against the crotch.</p>

<p>7. Protruding seat back view</p> 	<p>The fabric pulls taut over the buttocks. The strain causes the fabric to cup under the abdomen. The side seams curve toward the back at the hipline and diagonal wrinkles radiate from the buttocks toward each side seam. The waistband and hip fitting line drop across the centre back area because the fabric binds against the crotch.</p>
<p>8. Flat seat back view</p> 	<p>The trousers are loose across the buttocks. Loose diagonal wrinkles droop from the upper side seam area toward the buttocks. The hip fitting line drops across the centre back area. Loose diagonal wrinkles droop downward from the side seams and inseams toward the crease lines on each trouser leg.</p>
<p>9. Prominent abdomen front and side view</p> 	<p>The fabric is taut across the abdomen. The side seams above the hip curve bows forward. The strain may cause a horizontal fold of fabric to form at the front waistline. At the centre front the trousers cup under the abdomen, the hip fitting line rises. Diagonal wrinkles pull from the abdomen to the side seams and cause the seams to slant towards the front. Trousers with fitted waistbands bind uncomfortably tight against the crotch and cause diagonal wrinkles to form from the crotch to the hip bone.</p>

<p>10. Protruding front thighs</p> <p>front and side view</p> 	<p>The fabric pulls taut across the front surface of the upper thigh area and cups under the buttocks. The side seams curve towards the front. Horizontal folds form across each inseam near the crotch and may cause the front crease lines to curve toward each other at the thigh and hang toward each other at the hem.</p>
<p>11. Swayback</p> <p>back and side view</p> 	<p>The fabric under the buttock is taut and pulls into wrinkles which slant toward the inseams. When the variation is extreme, the strain may pull the waistband and hip fitting line down across the centre back area.</p>
<p>12. Pelvic tilt toward</p> <p>back and side view</p> 	<p>The fabric sags diagonally under the curve of the buttocks and at the back crease lines. The front of the trousers may bind against the crotch. The hip fitting line and hemline drop in the back and rise in the front.</p>

ANNEXURE L: FIT JUDGING TRAINING MANUAL

The five elements of fit are grain, set, line balance and ease, each are discussed.

1. Grain

Definition and description:

Grain is the orientation of the yarns that make up the fabric. Two sets of yarns are woven at right angles to each other to make up a fabric. These are the warp yarns that run lengthwise and weft yarns that run crosswise. For a garment to have a good fit, it must be cut on grain. The horizontal yarns of the fabric need to run parallel through the whole length of the body at centre front and centre back.

Standards for fit judging with grainline:

The first fabric characteristic to consider when evaluating the fit of a garment is grainline. A well-planned garment will produce perpendicular intersections of the two fabric grains. If the yarns are not properly aligned, the garment will not present the desired effect. Even very small differences of poor grain alignment can produce noticeable changes in the hang of the fabric and the fit of the garment. When grain is inappropriately aligned to the garment, it changes the aesthetic and functional quality of the finished garment.

To observe accuracy or deviation in the garment fit, the position of the fabric grain or marked grainlines against the body needs to be carefully observed. A corrected grain deviation created balance on a symmetrical body, this results in both sides of the garment to lie equally smooth and relaxed because the pull of gravity is equal. On a basic-fitted garment, the length grain should lie perpendicular to the floor at the sides, the centre front and centre back; the crossgrain should lie parallel to the floor across the centre front and centre back.

When a 'non-standard' figure, the grainline lies skew or bows because each figure variation requires its specific amount of length and width of fabric. A lack of or excess of fabric length and width causes tension wrinkles or loose folds in the garment area and the grainline becomes distorted. The more the grainline deviates from the standard, the more it will slope or bow as fabric ease is 'borrowed' and pulled to another area or allowed to sag.

Problems:

Garments that do not fit well hang skew and often affect wearer comfort and affect grain direction and pulls it off grain. When a garment is extremely off-grain, it can have a noticeably crooked hang. Some examples of this are twisted trouser legs, undesirable sagging and pleats that fall open.

2. Set

Definition and description:

Set refers to a smooth fit without any undesirable wrinkles. When a garment fits to the wearer's body poorly, wrinkles (not the type that can be ironed out) can be formed due to poor set. Set wrinkles occur when a garment is too large or too small causing the garment fabric to hang or pull in the area of poor fit. Once again, poor posture or a body flaws can cause inadequate set. The location and wrinkle type can determine the exact cause of poor fit.

Problems:

- Horizontal wrinkles under tension are caused because of the garment being too tight for the body area just above or below the wrinkles for example, trousers with horizontal wrinkles at the hip level.
- Loose, horizontal wrinkles are caused by the garment being too long for the body for example, trousers on a person with a full pelvic tilt, causes the horizontal

wrinkles or folds in the centre back below the waistband because the trousers are longer for the body in that area.

- Loose, vertical wrinkles are caused because of a garment being too big in that area for example vertical folds along leg length indicate that the leg width is too big.
- Vertical wrinkles under tension are caused as a result of a garment being too short in that area for example, trousers with vertical wrinkles in the crotch area indicates that the crotch seam is too short for the wearer.
- Diagonal wrinkles are as a result of the body curve being too large for the garment or that the garment lacks sufficient shaping to fit the particular body curve for example, a baywindow causes trousers to be too tight across the abdomen forming wrinkles that point towards the curve.

3. Line

Definition and description:

Line refers to the alignment of the structural lines of a garment as with the natural lines of the body. Poor design or construction can result in an out-of-line garment. A body that is not standard can also cause the distortion of lines on a garment. Some lines outline the body while others encompass the circumference of the body.

Standards from which a garment must not deviate:

- The waistline lies on the natural waist and is parallel to the floor whether sitting or standing.
- The side seamlines are straight; they hang perpendicular to the floor and visually bisect the body.
- The hemlines for full-length trousers by standards and not fashion, extend to the top of the heel at the back 2,5cm-5cm from the floor, and touch only the top of the shoe in the front.

- The centre front and centre back lines should fall straight down the centre front and centre back of the body
- The darts should appear as straight lines that follow the body parts they are intended to fit.

4. Balance

Definition and description:

Balance occurs when the garment is in symmetry. The left and right halves of the garment must appear balanced when viewed from the front, back and side view, in order to appear well fitted. Factors causing a garment to be unbalanced, is a poor posture, body flaws and poor construction techniques. Trousers legs appear balanced when the fabric is evenly distributed around the legs. Balance is related to the fit elements grain and line.

Standards for fit judging with balance:

The eye is quickly drawn to any structural lines of a garment, such as darts, seams, pleats, tucks and trims. At the same time, the eye compares the garment to the corresponding vertical or horizontal centre of the body area and aligns the two. These perceptions and comparisons determine the degree of balance of the garment. Balance is achieved from visually equal garment weight, size, or the distance from the body centre line.

When the garment pulls or drops from its expected position on the body, the garment appears instable and uncomfortable. Balance in a garment is distorted with an increase in the level of misallocation of structural lines or the degree of snugness or looseness to the body. The garment is in harmony with the body when all the structural lines divide the body into the correct proportions. Both the wearer and observer sense its visual and physical comfort.

Problems:

A garment that is off grain will result in a misbalance causing the garment to hang skew on the body. If the line of the garment does not bisect the natural line of the body, the garment hangs out of balance. Balance in a garment is distorted with an increase in the level of misallocation of structural lines or the degree of snugness or looseness to the body.

5. Ease

Definition and description:

Ease is the amount of free space between the wearer and the garment. The amount of ease required in a garment for the purpose of comfort, movement and attractiveness, is dependent on the design, the fabric, the wearer's body, the occasion and personal preference.

Standards for fit judging with ease:

The standards for judging ease will be performed in the motor test. The only standard to be observed with the subjects standing in one position is the appearance of adequate ease to the wearer's body.

Problems:

An inadequate amount of ease causes a garment to have poor set and distortion of structural lines.

- The trousers appear to have folds and bulging where there is an excess of ease.
- Without the minimal amount of ease the trousers appear tight and wrinkled, and are worn out faster from strain on seams and the fabric.

ANNEXURE M: GENERAL FIT COMPLAINTS COMPARED WITH WEARER CHARACTERISTICS

Wearer characteristics	Category	n	Subject no.	Fit complaints				
				Bulkiness in hip area	Large/low waist	Too long trouser legs	Crotch area too deep	Tightness in thigh area
Height	Extra short	-	55	X	-	X	X	-
			2	X	X	X	X	X
			1	X	-	X	-	-
	Total	3	-	3	1	3	2	1
	Short	-	6	-	-	-	-	-
			23	X	X	X	X	X
			59	X	X	X	X	X
			24	X	-	X	-	X
			22	-	-	-	-	-
			27	X	-	-	-	X
			18	X	X	-	X	X
			3	X	X	X	X	-
			60	-	-	-	-	-
			42	-	X	X	X	-
	Total	10	-	6	5	5	5	5
	Regular	-	47	-	X	X	-	-
			30	X	X	-	-	X
			45	X	X	-	-	-
			21	-	X	-	-	X
			8	X	X	X	X	-
			5	X	X	X	X	-
	Total	6	-	4	6	3	2	2
	Tall	-	35	-	-	-	-	-
			43	X	X	X	X	X
	Total	2	-	1	1	1	1	1
	Grand total	21	-	14	13	12	10	9

Wearer characteristics	Category	n	Subject no.	Fit complaints				
				Bulkiness in hip area	Large/low waist	Too long trouser legs	Crotch area too deep	Tightness in thigh area
BMI	Normal	-	47	-	X	X	-	-
			6	-	-	-	-	-
			30	X	X	-	-	X
			18	X	X	-	X	X
			3	X	X	X	X	-
			2	X	X	X	X	X
			8	X	X	X	X	-
			42	-	X	X	X	-
	Total	8	-	5	7	5	5	3
	Overweight	-	35	-	-	-	-	-
			23	X	X	X	X	X
			59	X	X	X	X	X
			55	X	-	X	X	-
			24	X	-	X	-	X
			43	X	X	X	X	X
			45	X	X	-	-	-
			21	-	X	-	-	X
			22	-	-	-	-	-
			27	X	-	-	-	X
			5	X	X	X	X	-
			60	-	-	-	-	-
			1	X	-	X	-	-
	Total	13	-	9	6	7	5	6
	Grand total	21	-	14	13	12	10	9

Wearer characteristics	Category	n	Subject no.	Fit complaints				
				Bulkiness in hip area	Large/low waist	Too long trouser legs	Crotch area too deep	Tightness in thigh area
Body types	Baywindow	-	35	-	-	-	-	-
			55	X	-	X	X	-
			43	X	X	X	X	X
			22	-	-	-	-	-
			27	X	-	-	-	X
			2	X	X	X	X	X
			5	X	-	X	X	-
			60	-	-	-	-	-
			42	-	X	X	X	-
			1	X	-	X	-	-
	Total	10	-	6	3	6	5	3
	High protruding buttocks	-	35	-	-	-	-	-
			23	X	X	X	X	X
			59	X	X	X	X	X
			55	X	-	X	X	-
			24	X	-	X	-	X
			43	X	X	X	X	X
			45	X	X	-	-	-
			21	-	X	-	-	X
			22	-	-	-	-	-
			27	X	-	-	-	X
			2	X	X	X	X	X
			60	-	-	-	-	-
			42	-	X	X	X	-
			1	X	-	X	-	-
	Total	14	-	9	7	8	6	7
	Forward hip stance	-	23	X	X	X	X	X
			55	X	-	X	X	-
			24	X	-	X	-	X
			43	X	X	X	X	X
			21	-	X	-	-	X
			22	-	-	-	-	-
			3	X	X	X	X	-
			2	X	X	X	X	X
			5	X	X	X	X	-
			60	-	-	-	-	-
			42	-	X	X	X	-
			1	X	-	X	-	-
	Total	12	-	8	7	9	7	5
	Backward hip stance	-	35	-	-	-	-	-
			8	X	X	X	X	-
	Total	2	-	1	1	1	1	0
	Balanced body	-	47	-	X	X	-	-
			6	-	-	-	-	-
			30	X	X	-	-	X
	Total	3	-	1	2	1	0	1

ANNEXURE N: FUNCTIONALITY: MOTOR TEST RESULTS

Wearer characteristics		Problems with sitting on a chair and reaching																									
Category	n	Subject no.	Problems with kneeling			Problems with squats			Problems with body bends			Problems with walking			Problems with crawling			Crawling ratings	Problems with sitting on a chair and reaching					Sitting ratings			
			Tightness in the thigh area	Crotch area too low	Kneeling ratings	Tightness in the thigh area	Crotch area too low	Squats ratings	Tightness in the thigh area	Crotch area too low	Body bends ratings	Tightness in the thigh area	Crotch area too low	Chafing on inner thighs	Walking ratings	Tightness in the thigh area	Crotch area too low		Chafing on inner thighs	Trousers fall down at back waist area	Tightness over thigh area	Crotch area too low	Chafing on inner thighs		Trousers fall down at back waist area	Bulging of fabric in crotch area	
Height	Extra short	-	55	-	-	2	-	-	2	-	-	2	-	-	X	2	-	-	X	2	-	-	-	X	2		
		2	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	X	1		
		1	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	X	1		
	Total	3	-	2	2	-	2	2	-	2	2	-	0	0	1	-	2	2	0	1	-	0	0	0	0	3	-
	Short	-	6	X	X	2	X	X	2	X	X	1	-	-	-	1	X	X	-	-	2	-	-	-	-	X	2
		23	X	X	3	X	X	3	X	X	2	-	-	-	2	X	X	-	X	2	X	X	-	X	X	2	
		59	X	X	3	X	X	2	-	-	1	-	-	-	2	-	-	-	-	2	-	-	-	-	-	1	
		24	X	X	3	X	X	3	-	-	1	-	-	-	2	-	-	-	-	2	X	-	-	X	X	2	
		22	-	-	2	-	-	2	-	-	1	-	-	-	2	-	-	-	-	2	-	-	-	-	-	2	
		27	X	-	2	X	-	3	X	-	2	-	-	X	2	X	-	-	-	2	X	-	-	-	-	2	
		18	X	X	2	X	X	2	-	-	1	-	-	-	2	X	X	-	-	2	-	-	-	X	X	2	
		3	-	-	1	-	-	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	
		60	-	-	1	-	-	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	X	1	
	42	X	X	2	X	X	2	-	X	2	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1		
	Total	10	-	7	6	-	7	6	-	3	3	-	0	0	1	-	4	3	0	1	-	3	1	0	3	5	-
	Regular	-	47	-	X	1	X	X	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1
		30	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	-	X	2	
		45	X	X	3	X	X	3	-	-	1	X	X	-	2	X	X	-	-	2	-	-	-	-	X	1	
		21	X	X	3	-	-	3	X	X	2	-	-	X	2	X	X	-	X	2	X	X	-	X	-	2	
		8	X	X	2	X	X	2	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	
5		X	X	2	X	X	2	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	X	-	2		
Total	6	-	5	6	-	5	5	-	2	2	-	1	1	1	-	3	3	0	1	-	1	1	0	2	2	-	
Tall	-	35	X	X	3	X	X	2	-	-	1	-	-	-	2	-	X	-	-	1	-	-	-	-	X	1	
	43	X	-	3	X	-	1	-	-	2	-	-	X	2	X	-	X	X	3	-	-	-	-	-	1		
Total	2	-	2	1	-	2	1	-	0	0	-	0	0	1	-	1	1	1	1	-	0	0	0	0	1	-	
Grand total	21	-	16	15	-	16	14	-	7	7	-	1	1	4	-	10	9	1	4	-	4	2	0	5	11	-	

Wearer characteristics		Category	n	Subject no.	Problems with kneeling		Kneeling ratings	Problems with squats		Squats ratings	Problems with body bends		Body bends ratings	Problems with walking			Walking ratings	Problems with crawling				Crawling ratings	Problems with sitting on a chair and reaching forward					Sitting ratings
				Tightness in the thigh area	Crotch area too low	Tightness in the thigh area		Crotch area too low	Tightness in the thigh area		Crotch area too low	Tightness in the thigh area		Crotch area too low	Chafing on inner thighs	Tightness in the thigh area		Crotch area too low	Chafing on inner thighs	Trousers fall down at back waist area	Tightness in the thigh area		Crotch area too low	Chafing on inner thighs	Trousers fall down at back waist area	Bulging of fabric in crotch area		
BMI	Normal	-	47	-	X	1	X	X	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	
			6	X	X	2	X	X	2	X	X	1	-	-	-	1	X	X	-	-	2	-	-	-	-	X	2	
			30	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	X	X	2	
			18	X	X	2	X	X	2	-	-	1	-	-	-	2	X	X	-	-	2	-	-	-	-	X	2	
			3	-	-	1	-	-	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	
			2	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	-	X	1	
			8	X	X	2	X	X	2	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	
			42	X	X	2	X	X	2	-	X	2	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	
	Total	8	-	6	7	-	7	7	-	3	4	-	0	0	0	-	4	4	0	0	-	0	0	0	1	4	-	
	Over - weight	-	35	X	X	3	X	X	2	-	-	1	-	-	-	2	-	X	-	-	1	-	-	-	-	X	1	
			23	X	X	3	X	X	3	X	X	2	-	-	-	2	X	X	-	X	2	X	X	-	X	X	2	
			59	X	X	3	X	X	2	-	-	1	-	-	-	2	-	-	-	-	2	-	-	-	-	-	1	
			55	-	-	2	-	-	2	-	-	2	-	-	X	2	-	-	-	X	2	-	-	-	-	X	2	
			24	X	X	3	X	X	3	-	-	1	-	-	-	2	-	-	-	-	2	X	-	-	X	X	2	
			43	X	-	3	X	-	1	-	-	2	-	-	X	2	X	-	X	X	3	-	-	-	-	-	1	
			45	X	X	3	X	X	3	-	-	1	X	X	-	2	X	X	-	-	2	-	-	-	-	X	1	
			21	X	X	3	-	-	3	X	X	2	-	-	X	2	X	X	-	X	2	X	X	-	X	-	2	
			22	-	-	2	-	-	2	-	-	1	-	-	-	2	-	-	-	-	2	-	-	-	-	-	2	
			27	X	-	2	X	-	3	X	-	2	-	-	X	2	X	-	-	-	2	X	-	-	-	-	2	
			5	X	X	2	X	X	2	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	X	-	2	
			60	-	-	1	-	-	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	X	1	
			1	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	-	X	1	
	Total	13	-	10	8	-	9	7	-	4	3	-	1	1	4	-	6	5	1	4	-	4	2	0	4	7	-	
	Grand total	21	-	16	15	-	16	14	-	7	7	-	1	1	4	-	10	9	1	4	-	4	2	0	5	11	-	

Wearer characteristics	Category	n	Subject no.	Problems with kneeling			Kneeling ratings	Problems with squats			Squats ratings	Problems with body bends			Body bends ratings	Problems with walking			Walking ratings	Problems with crawling					Crawling ratings	Problems with sitting on a chair and reaching forward						Sitting ratings
				Tightness in the thigh area	Crotch area too low	Tightness in the thigh area		Crotch area too low	Tightness in the thigh area	Crotch area too low		Tightness in the thigh area	Crotch area too low	Tightness in the thigh area		Crotch area too low	Chafing on inner thighs	Tightness in the thigh area		Crotch area too low	Chafing on inner thighs	Trousers fall down at back waist area	Tightness in the thigh area	Crotch area too low		Chafing on inner thighs	Trousers fall down at back waist area	Bulging of fabric in crotch area				
Body type	Bay window	-	35	X	X	3	X	X	2	-	-	1	-	-	-	2	-	X	-	-	-	1	-	-	-	-	X	1				
			55	-	-	2	-	-	2	-	-	2	-	-	X	2	-	-	-	X	2	-	-	-	-	-	X	2				
			43	X	-	3	X	-	1	-	-	2	-	-	X	2	X	-	X	X	3	-	-	-	-	-	-	1				
			22	-	-	2	-	-	2	-	-	1	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-	2				
			27	X	-	2	X	-	3	X	-	2	-	-	X	2	X	-	-	-	2	X	-	-	-	-	-	2				
			2	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	-	-	X	1				
			5	X	X	2	X	X	2	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	X	-	2					
			60	-	-	1	-	-	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	X	1				
			42	X	X	2	X	X	2	-	X	2	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1				
			1	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	-	-	X	1				
	Total	10	-	7	5	-	7	5	-	4	3	-	0	0	3	-	4	3	1	2	-	1	0	0	1	5	-					
	High protruding buttocks	-	35	X	X	3	X	X	2	-	-	1	-	-	-	2	-	X	-	-	-	1	-	-	-	-	X	1				
			23	X	X	3	X	X	3	X	X	2	-	-	-	2	X	X	-	X	2	X	X	-	X	X	2					
			59	X	X	3	X	X	2	-	-	1	-	-	-	2	-	-	-	-	2	-	-	-	-	-	1					
			55	-	-	2	-	-	2	-	-	2	-	-	X	2	-	-	-	X	2	-	-	-	-	-	X	2				
			24	X	X	3	X	X	3	-	-	1	-	-	-	2	-	-	-	-	2	X	-	-	X	X	2					
			43	X	-	3	X	-	1	-	-	2	-	-	X	2	X	-	X	X	3	-	-	-	-	-	-	1				
			45	X	X	3	X	X	3	-	-	1	X	X	-	2	X	X	-	-	2	-	-	-	-	-	X	1				
			21	X	X	3	-	-	3	X	X	2	-	-	X	2	X	X	-	X	2	X	X	-	X	-	-	2				
			22	-	-	2	-	-	2	-	-	1	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-	2				
			27	X	-	2	X	-	3	X	-	2	-	-	X	2	X	-	-	-	2	X	-	-	-	-	-	2				
			2	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	-	-	X	1				
			60	-	-	1	-	-	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	X	1				
			42	X	X	2	X	X	2	-	X	2	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1				
			1	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	-	-	X	1				
	Total	14	-	11	9	-	10	8	-	5	5	-	1	1	4	-	7	6	1	4	-	4	2	0	3	8	-					
	Forward hip stance	-	23	X	X	3	X	X	3	X	X	2	-	-	-	2	X	X	-	X	2	X	X	-	X	X	2					
			55	-	-	2	-	-	2	-	-	2	-	-	X	2	-	-	-	X	2	-	-	-	-	-	X	2				
			24	X	X	3	X	X	3	-	-	1	-	-	-	2	-	-	-	-	2	X	-	-	X	X	2					
			43	X	-	3	X	-	1	-	-	2	-	-	X	2	X	-	X	X	3	-	-	-	-	-	-	1				
			21	X	X	3	-	-	3	X	X	2	-	-	X	2	X	X	-	X	2	X	X	-	X	-	-	2				
			22	-	-	2	-	-	2	-	-	1	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-	2				
			3	-	-	1	-	-	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1				
			2	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	-	-	X	1				
			5	X	X	2	X	X	2	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	X	-	2					
			60	-	-	1	-	-	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	X	1				
			42	X	X	2	X	X	2	-	X	2	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1				
			1	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	-	-	X	1				
	Total	12	-	8	7	-	7	6	-	4	5	-	0	0	3	-	5	4	1	4	-	3	2	0	4	6	-					
	Backward hip stance	-	35	X	X	3	X	X	2	-	-	1	-	-	-	2	-	X	-	-	1	-	-	-	-	-	X	1				
			8	X	X	2	X	X	2	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1				
	Total	2	-	2	2	-	2	2	-	0	0	-	0	0	0	-	0	1	0	0	-	0	0	0	0	1	-					
	Balanced body	-	47	-	X	1	X	X	1	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	1				
			6	X	X	2	X	X	2	X	X	1	-	-	-	1	X	X	-	-	2	-	-	-	-	X	2					
			30	X	X	2	X	X	2	X	X	2	-	-	-	1	X	X	-	-	2	-	-	-	-	X	2					
			18	X	X	2	X	X	2	-	-	1	-	-	-	2	X	X	-	-	2	-	-	-	X	X	2					
	Total	4	-	3	4	-	4	4	-	2	2	-	0	0	0	-	3	3	0	0	-	0	0	0	1	3	-					