



THESIS APPROVAL

GRADUATE SCHOOL, KASETSART UNIVERSITY

Doctor of Philosophy (Tropical Agriculture)

DEGREE

Tropical Agriculture

Interdisciplinary Graduate Degree

FIELD

PROGRAM

TITLE: The Development of Thai Standard Size Models

NAME: Mrs. Srikanjana Jatuphatwarodom

THIS THESIS HAS BEEN ACCEPTED BY

THESIS ADVISOR

(Assistant Professor Kajjarus Piromthamsiri, Ph.D.)

COMMITTEE MEMBER

(Associate Professor Banyat Saitthiti, D.Eng.)

COMMITTEE MEMBER

(Associate Professor Kulkanit Rashainbunyawat, Ph.D.)

PROGRAM CHAIRMAN

(Associate Professor YingYong Paisooksantivatana, Ph.D.)

APPROVED BY THE GRADUATE SCHOOL ON

DEAN

(Associate Professor Gunjana Theeragool, D.Agr.)

THESIS

THE DEVELOPMENT OF THAI STANDARD SIZE MODELS



SRIKANJANA JATUPHATWARODOM

A Thesis Submitted in Partial Fulfillment of
The Requirement for the Degree of
Doctor of Philosophy (Tropical Agriculture)
Graduate School, Kasetsart University
2010

Srikanjana Jatuphatwarodom 2010: The Development of Thai Standard Size Models. Doctor of Philosophy (Tropical Agriculture), Major Field: Tropical Agriculture, Interdisciplinary Graduate Program Thesis Advisor: Mrs. Kajjarus Piromthamsiri, Ph.D. 108 pages.

The objectives of this dissertation were: 1) to determine standard sizes of Thai men and women. 2) to compare the particular standard sizes among Thai, American, British and Japanese. 3) to select the suitable materials for Thai model construction and 4) to construct and evaluate the performance of the developed models. The Thai body structure data (Step 4) collected in the years 2000-2001 were used to determine the Thai sizes. The grading sizes were calculated by dividing the range into 7 intervals. By considering those intervals, the mean was assigned as medium sizes (M). The others were extra extra small (XXS), extra small (XS), small (S), large (L), extra large (XL), and extra extra large (XXL). The shell fabrics used were the light weight cotton (A1), the medium weight cotton (A2) and the heavy weight cotton (A3). The underlining fabrics consisted of 8 mm. thick sponge (B1), 600 g/m² polyester nonwovens (B2) and 200 g/m² polyester nonwovens (B3). There were nine sets of combination between the shell fabrics and underlining fabrics. The first was A1B1. The others were A1B2, A1B3, A2B1, A2B2, A2B3, A3B1, A3B2 and A3B3. All of nine sets had been tested for tensile strength and bursting strength before and after needle punching. The best three sets were selected for the models construction. Thai standard size models were constructed by papier - mache techniques. Three male models and three female models were constructed.

The results were as follows: 1) Thai men's small sizes were 87.00 cm bust, 79.00 cm waist, 90.00 cm hip. Thai men's medium sizes were 90.00 cm bust, 82.00 cm waist, 93.00 cm hip. Thai men's large sizes were 93.00 cm bust, 85.00 cm waist, 96.00 cm hip. Thai women's small sizes were 84.00 cm bust, 68.00 cm waist, 91.00 cm hip. Thai women's medium sizes were 87.00 cm bust, 71.00 cm waist, 94.00 cm hip, and Thai women's large sizes were 90.00 cm bust, 74.00 cm waist, 97.00 cm hip. 2) The bust size of Thai men was smaller than Japanese, British and American sizes while the waist and hip sizes were smaller than British and American sizes but larger than Japanese size. The bust size of Thai women was smaller than British and American sizes but larger than the Japanese size. The waist size of Thai women was larger than Japanese, British and American sizes. The hip size of Thai women was smaller than British size but larger than Japanese and American sizes. 3) A2B2, A3B2 and A3B3 fabric combinations were most strong regarding to before and after needle punching tensile strength and bursting strength. Therefore, the fabrics had been used to make three men models and three women models. 4) The results of performance evaluation indicated that the No.2 (A3B2) men model and the No.2 women model had higher performance score than the No.1(A2B2) and the No.3 (A3B3) models due to the ease of fixing pin.

Student's signature

Thesis Advisor's signature

ACKNOWLEDGEMENTS

I would like to grateful thank and deeply indebted to Assit.Prof.Dr. Kajjarus Piromthamsiri my thesis advisor for advice, encouragement and valuable suggestion for completely writing of thesis.

I would like to sincerely thank Assoc. Prof. Dr. Banyat Saitthiti and Assoc. Prof. Dr. Kulkanit Rashainbunyawat, my committees for their member comments, suggestion and encouragement. I would like to sincerely thank Asst. Prof. Dr. Wandee Thaitanich, external examiner for her suggestion and writing direction.

I would like to thank Assoc. Prof. Dr. Ying Yong Paisooksantivatana, Graduate program committee chairperson for his interest and support. As well as I would like to thank Assoc. Prof. Dr. Gunjana Theeragool, Dean of the graduate school for interest and support.

This research was supported by Rajamangala University of Technology of Thanyaburi (RMUTT) and New World International LTD.Part for raw materials and laboratory analysis.

I am especially appreciated my parents, my husband and my sons for unending heartfelt support, love and care, my friends in the department of textile & clothing, home economics technology, RMUTT for their friendship, continuous support and help, and fellow graduate students, for friendship and continuous help.

Srikanjana Jatuphatwarodom

May 2010

TABLE OF CONTENTS

	Page
TABLE OF CONTENTS	i
LIST OF TABLES	ii
LIST OF FIGURES	v
INTRODUCTION	1
OBJECTIVES	4
LITERATURE REVIEWS	5
MATERIAL AND METHODS	52
Materials	52
Methods	62
RESULTS AND DISCUSSION	65
Results	
CONCLUSION AND RECOMMENDATION	94
Conclusion	94
Recommendation	99
LITERATURE CITED	100
APPENDICES	103
Appendix A: Models Performance Evaluation Form	104
Appendix B: The List of Participations	106
CIRRICULUM VITAE	108

LIST OF TABLES

Table	Page	
1	Comparison of different women sizing systems	5
2	Analysis of survey measurements	9
3	Prime divisions of girth	10
4	Women's wear and men's wear sizes	15
5	Sizes charts for men	19
6	Sizes charts for women	22
7	Size chart of Germany - medium height men (for regular fitting covergarment)	23
8	Size chart of USA- medium height men	23
9	Size chart of Japan - height men	24
10	Size chart of Holland - varying height average bust women	24
11	Size chart of Canada - short waist short leg women	25
12	Size chart of Israel - dynamic height average bust women	25
13	Size chart of Australia - average women	26
14	Size chart of USA - regular height women	27
15	Size chart of England - medium height women	26
16	Size chart of France - medium height women	27
17	Size chart of West germany - regular women	28
18	Size chart of Japan - women	28
19	Men's body measurement data	54
20	Women's body measurement data	58
21	Mean of each body measurement of Thai men	65
22	Range and grading size of each body measurement for the Thai men standard sizes	66
23	Calculated and adjusted mean and grading size of each body measurement for the Thai men standard size	67

LIST OF TABLES (Continued)

Table		Page
24	Thai men standard sizes	68
25	Mean of each body measurement of Thai women	69
26	Range and grading size of each body measurement for the Thai women standard sizes	70
27	Calculated and adjusted mean and grading size of each body measurement for the Thai women standard sizes	71
28	Thai women standard size	72
29	Thai, Japanese, British and American men medium sizes	74
30	The ratio of Thai men medium size to Japanese, British and American men sizes	75
31	Thai, Japanese, British and American women medium sizes	75
32	The ratio of Thai women medium sizes to Japanese, British and American women medium sizes	76
33	Mean tensile strength of the shell and interlining fabrics	77
34	Mean bursting strength of the shell and interlining fabrics	78
35	Mean tensile strength of the fabric combinations before needle punching	79
36	Mean tensile strength of the fabric combinations after needle punching	80
37	Mean bursting strength of the fabric combinations before needle punching	81
38	Mean bursting strength of the fabric combinations after needle punching	81
39	The ranking of tensile strength and bursting strength of the fabric combinations	82

LIST OF TABLES (Continued)

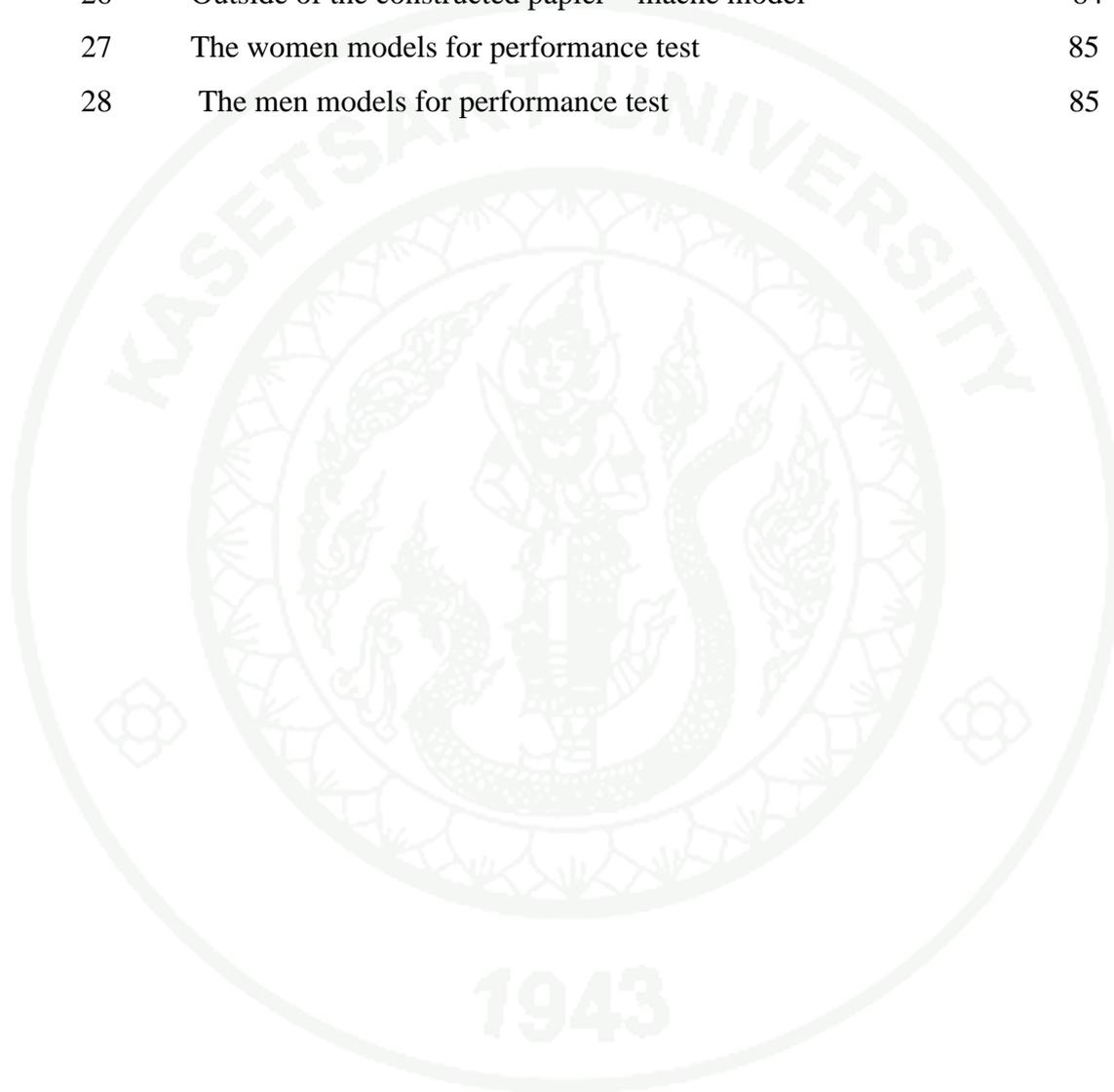
Table		Page
40	Gender of the evaluators.	86
41	Education of the evaluators	87
42	Income of the evaluators	87
43	Experience of the evaluators	88
44	Performance scores of the number one (A2B2) men model	88
45	Performance scores of the number two (A3B2) men model	89
46	Performance scores of the number three (A3B3) men model	89
47	Performance scores of the number one (A2B2) women model	90
48	Performance scores of the number two (A3B2) women model	91
49	Performance scores of the number three (A3B3) women model	91
50	A comparison of total performance scores of the constructed models	92

LIST OF FIGURES

Figure		Page
1	The locations of the width grade division	10
2	Examples of labels for men outerwear	12
3	Examples of inclusion of women size code number into label	13
4	Body measurements for men's size	18
5	Body measurements for women's size (Horizontal)	20
6	Body measurements for women's Size (Vertical)	21
7	Tools and equipment for model construction	30
8	Modeling	31
9	Carving	32
10	Casting	33
11	Papier – mache portraying (a)covering paper on sculpture and (b) glue painting.	34
12	Men and women structure	36
13	Men model	37
14	Women model	37
15	Britain's men model	38
16	Britain's women model	38
17	Germany's half-length men model	39
18	Britain's full -length women model	39
19	Basic weaves : (a) plain weave, (b) twill weave and (c) satin weave	47
20	Knits : (a) weft knits (b) warp knits	48
21	The body descriptions selected for Thai men sizes	53
22	The body descriptions selected for Thai women sizes	57
23	The papier – mache men model	83
24	The papier – mache women model	83
25	Inside of the constructed papier – mache model	84

LIST OF FIGURES (Continued)

Figure		Page
26	Outside of the constructed papier – mache model	84
27	The women models for performance test	85
28	The men models for performance test	85



THE DEVELOPMENT OF THAI STANDARD SIZE MODELS

INTRODUCTION

Garment export has been an important business in Thailand. In January - April, 2010 the export market of Thai garments was as follows, 314.50 million US dollars to the U.S.A, 263.10 million US dollars to the E.U., 59.70 million US dollars to Japan, 25.80 million US dollars to Asean, 10.63 million US dollars to China and 33.83 million US dollars to Other markets (Thai garment manufacturers association, 2010).

However, the textile manufacturers of Thailand have imported fabrics from top 5 Countries. In January - April, 2010, the textile industry of Thailand imported 218.50 million US dollars from China, 79.4 million US dollars from Taiwan, 34.9 million US dollars from Japan, 24.9 million US dollars from South Korea, 22.50 million US dollars from Hongkong and 97.1 million US dollars from Others. (Department of foreign trade, 2010). Consequently, the Thai garment exports had more value than imports. Approximately 90 percent of garment production in Thailand has been executed on an original equipment manufacturing (OEM) basis. While this arrangement has been acceptable both for the manufacturers and the buyers alike, as the industry developed, it has not benefited the country in the long term. Today, as manufacturers find themselves squeezed between high operating costs and low - priced competition, they face the need to do more than to accept reduced margins. On the other hand, a leap toward own design manufacturing (ODM) or own brand manufacturing (OBM) is easier said than done; it is unrealistic to expect the industry to change its structure overnight. Thailand's department of export promotion has also been pitching in by providing Thai brands with highly visible " Window " retail outlets in fashion capitals of the world to raise further awareness. The campaign includes grouping designers and brands under one roof on New York's prestigious fifth avenue (Guillaume, 2005).

Garment manufacturers employ a lot of people. A basic problem has been the lack of experienced workers and the absence of employees. There was a study about professional competencies of ready - made garment patternmakers required by exporters. The findings of the study revealed that professional competencies, in both theoretical knowledge and professional skills, were equally essential for patternmakers. The three aspects of theoretical knowledge rated most essential were sewing, designing, and sizing according to customers' age. Two aspects of theoretical knowledge rated very essential were body structures of people in various countries and types of female's wear. The seven aspects of professional skills rated most essential were the skill of allowing seams, using computers, using markers and abbreviations, utilising tools and equipment, making paper patterns, making and altering patterns and using materials. Consequently, the pattern-making process has become an important step in garment manufacturing, and has assumed the role as the heart of all ready-made garment production processes (Ritnim, 1993).

Most pattern manufacturers have specific skills. Ready-made garment patternmaking is different from order clothing pattern-making in term of sizes, tools and equipments. Important equipments used in pattern-making are models, mannequins and dummies. The dummy is a dressmaking form in the shape of a human body on which the designer or home sewer drapes clothes before sewing. It is also called a dressform, a dressmaker's dummy, a dressmaker's form and a model form (Calasibetta, 1998). The standard model's body has been used for patternmaking, fitting etc. Additionally, apparel fitting problems are costing and frustrating, not only for consumers, but also for apparel manufacturers and retailers, whether the expense comes in the form of returned merchandise, lost sales, brand dissatisfaction or wasted time in the fitting room. The extensiveness of the problem has been serious. Kurt Salmon Associates (KSA) study has indicated that 50 percent of women and 62 percent of men could not find a good fit in apparel, and other studies have shown that 50 percent of catalogue returns were because of fitting problems (Desmarteau, 2004). In Thailand, manufacturers models must be imported from the United Kingdom, the United

States and Italy. The cost of a model is about 60,000 - 100,000 Thai baht; Therefore, it is difficult for vocational schools and SME manufacturers to afford foreign-made models.

Bangkok Fashion City Project is a project of the Thai government which aims for leadership in tropical fashion. The successful project must have some basic factors, such as a perfect database, the best materials and suitable equipment. However, Thai garment factories have no Thai standard sizes to use. From that reason, they have been using Japanese or French standard sizes. By having the mentioned problem, garment producers must upgrade and re-structure the processes, prepare the manufacturer to be the centre of excellence in fashion and improve production and management (Jamkajornkeial, 2002). Furthermore, if Thai standard sizes is going to be used for the system, Thai garment manufactures should obtain Thai men and women standard sizes. In addition, there should have testing to determine the best material to make Thai standard size models. In the future, with having the standard production equipment for patternmaking and fitting which that would raise standard of ready-to-wear production to the international level. Thai students, instructors and manufacturers would be benefited by having the appropriate equipment to use. Furthermore, this would reduce the cost of using of the models from oversea which are more expensive and would help rising and supporting of Thai local handmade products.

Definition

Thai standard sizes refer to average measurements of Thai men and Thai women.

Thai model refers to the models of Thai male and female size used for patternmaking and fitting.

OBJECTIVES

The objectives of this study were:

1. To determine standard sizes of Thai men and women.
2. To compare the particular standard sizes among Thai, American, British and Japanese.
3. To select the suitable materials for Thai models construction.
4. To construct and evaluate performance of the developed models.

LITERATURE REVIEW

In order to develop high quality Thai standard size models, it becomes necessary to do literature review which that regards to the important contents such as, international sizes, model construction, material for model making, structure of model, as mentioned below:

1. International sizes

There are three major sizing systems in the world, namely American sizes, British sizes and European or Continental sizes. A U.S. consumer measures the human body in inches and pounds but British and European consumers use centimeters and kilograms as shown in Table 1 (Brown and Rice, 2001).

Table 1 Comparison of different women sizing systems.

American size	British size	Continental sizes
6		34
8		36
10	32	38
12	33	40
16	35	42
18	38	44
20	39	48

Source: Brown and Rice (2001)

A. Size groupings All the major anthropometric surveys use a similar method for size grouping, which is based on two factors: height and bust type (Cooklin,1995). Using the data from the British survey as a basis, the factors are:

1. Height: There are three height groups, and their proportion in the outside range of sizes are as follows:

a) Tall: Women over 165 cm tall with an average height of 170 cm. These are 20% of all out sizes.

b) Medium: Women between 155 cm and 165 cm tall, with an average height of 160 cm. This group represents 55 % of all out sizes and is by far the largest section.

c) Short: Women under 155 cm tall with an average height of 150 cm. Short women represent 25 % all out sizes. The British average height grouping are very similar to those of other countries.

2. Bust type: This refers to the difference between the hip and bust girth, and the categories are:

a) Extra large bust : Bust girth is 10 cm larger than the hip girth.

b) Large bust: Bust girth is 5 cm larger than the hip girth.

c) Full bust: Bust girth is equal to hip girth.

d) Medium bust: Bust girth is 5 cm smaller than the hip girth.

e) Small bust: Bust girth is 10 cm smaller than the hip girth

f) Very small bust: Bust girth is 15 cm smaller than the hip girth.

g) Extremely small bust: Bust is 20 cm smaller than the hip.

In all the survey, type4 (medium bust) was considered to be the basic sizing relationship between the two girths.

3. Size group: It is generally accepted by clothing manufacturers that the women population is comprised of five main size groups and one sub-groups, with each group having distinctive features of physical development in relation to age and hip girth (Cooklin,1990). The major physical characteristics of these groups are:

a) Group 1: Infants (Age 0-3 years) The body form has very little definition and is characterized by a protuberant abdomen and stomach.

b) Group 2: Girls (Age 3-9 years) The body form in this group still lacks definition but tends towards a taller and slimmer development.

c) Group 3: Juvenile (Age 9-13 years) In this group, the waistline has more definition and the larger sizes show the beginnings of bust development.

d) Group 4: Teenage (Age 13-18 years) The smaller sizes in this group cover body forms which are beginning to take shape but are not yet fully developed. The larger sizes cater to a more well proportioned and developed figure.

e) Group 5: Women (Age 18-65 years) This is the group covered by all the surveys and is characterized by a well proportioned and fully developed figure.

f) Group 5A: Women's-Out sizes (Age 18-65 years) A maturely developed figure where the waist and hip girths are large in proportion to the bust girth than those in Group 5.

B. System development The development of the body grade: The finalized size charts of the surveys provided the basic data for developing the body grade and this information was analyzed in order to determine the common factors of measurement changes between all of the surveys. The procedure followed was:

1. The bust girth size interval of each size chart was used as the basic for all comparative calculations. The intervals were 5 cm for the American and British and 4 cm for West Germany and France. In all cases, the bust, waist and hip girth changed by the same amount.

2. All of the measurement which related to the body grade were extracted from each chart and the amounts by which they changed in relation to the bust girth interval was calculated. This change was expressed as a percentage of the particular bust girth interval used as shown in Figure 1.

British

Bust girth interval	5.0 cm	
Average across back interval	1.14 cm	
Percentage of change	$\frac{1.14 \text{ cm}}{5.0 \text{ cm}} \times 100$	= 22.8 %

3. The system development is divided into two main groups of grades.

a) Group 1: The Primary and Secondary Girth grades.

b) Group 2: The Primary and Secondary Length grades.

4. The geometric average of the percentage of change obtained for the same measurement from each chart was then calculated. Where necessary, the results were rounded off or modified according to practical and/ or commercial criteria.

some measurement, such as front neck to bust point and front neck to front waist required a different type of calculation because each survey used a different method and data for obtaining the measurement. In these two instances, the changes were calculated trig metrically and then expressed in percentages. The results of this analysis are shown in Table 2 (Cooklin,1990).

Table 2 Analysis of survey measurements.

Measurements	Percentage of bust girth size interval					Percentage of body grade
	American	British	Germany	France	Average	
A Bust, Waist & hip girth	100	100	100	100	100	100
C Bust arc anterior	62.6	62.6	-	-	62.6	62.5
D Across back	25	22.8	25	27.5	24.9	25
4F Neck base girth	16.9	15	17.5	27.5	18.68	25
G Shoulder length	3.6	3.9	2.5	static	3.27	12.5
I Width of bust	12.6	17.5	-	21.5	16.7	25
K Back neck to waist	Dynamic	Static	Static	Static	According to National size charts	
K Function of armhole	12.5	20	-	-	15.81	25
K Part function of front neck to bust	20.5	23	24.2	23.1	22.66	25
L Part function of front neck to bust	11	10.8	12.4	-	11.37	12.5
M Overall front length of waist	31.5	33.8	36.6	-	33.96	37.5
N Waist to hip	-	8.6	-	-	-	12.5

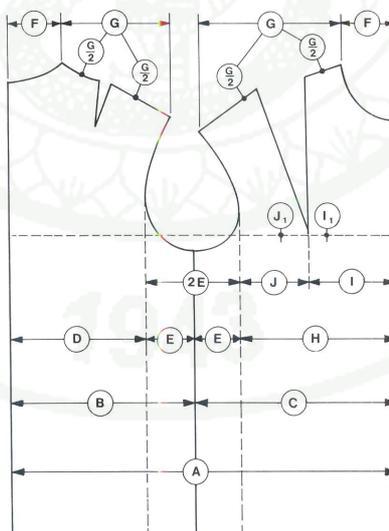
Source: Cooklin (1990)

All of the width divisions are described in Table 3 and their locations are shown in Figure 1.

Table 3 Prime divisions of girth.

Notation	Girth increments
A	Total pattern grade : from centre front to centre back
B	Total grade of back: from centre back to side seam
C	Total grade of front: from centre front to side seam
D	Across back: from centre back to armhole
E	Side section of front or back
F	Front or back neck width
G	Length of front or back shoulder
H	Width of breast: from centre front to front armhole on bust line
I	Centre front to bust point
J	Bust point to front armhole
I1	Front side of bust dart
J1	Armhole side of bust dart

Source: Cooklin (1990)

**Figure 1** The locations of the width grade division.

Source: Cooklin (1990)

Size intervals may vary country to country or from size range to size range, but it is widely accepted that the three major girths of bust, waist and hips all change by the same amount. Half of this amount is always equal to the total pattern grade and is notated A. For example, if the size interval was 4 cm, then the total grade of A = 2 cm or 20 mm.

5. Men size charts: The construction of any size chart is determined by two main factors: the type of garment and the market for which it is made (Winifred, 1990).

a) Type of garment: Different size charts are required for different types of garments, e.g.: Shirt – based on neck size (1 cm intervals). Suits – based on chest size (4 cm intervals). Casual or sportswear – based on chest sizes (X small, small, medium, large, X large).

b) Market: The actual measurements that complete a chart are determined by the type of man for which the garment is designed, e.g. young man, average man. Many manufacturers will also offer different size ranges, e.g. tall man, short man.

Size labeling: The Clothing Manufacturers' Federation, in 1980, recommended that in the short term manufacturers should show a metric conversion of their imperial measurements on their garment labels.

However as manufacturers move towards a complete metric system, they should follow the continental system of sizing, e.g.: Men's outer wear: suits, jackets, coats – 4 cm interval between sizes and the inclusion of the 100cm chest size. Trousers – 4 cm interval between waist sizes. Shirt – 1 cm interval between neck sizes. Additional information such as leg lengths on trousers or arm lengths on shirts may be included on the labels as additional information by a manufacturer.

The British Standard Institution has established a size designation system that indicates (in a simple, direct and meaningful manner) the body size of the man that a garment is intended to fit. The size designation of the system is based on the body and not garment measurements.

The size designation of each garment should comprise the control dimensions in centimeters of the intended wearer of the garment. Where practicable, the standard pictogram should be used as a means of indicating the size designation. Where it is not practicable to use the standard pictogram, the numerical value of the control dimensions should be given, together with the descriptive words such as chest girth, waist girth, etc as shown in Figure 2(BS 6185: 1982).

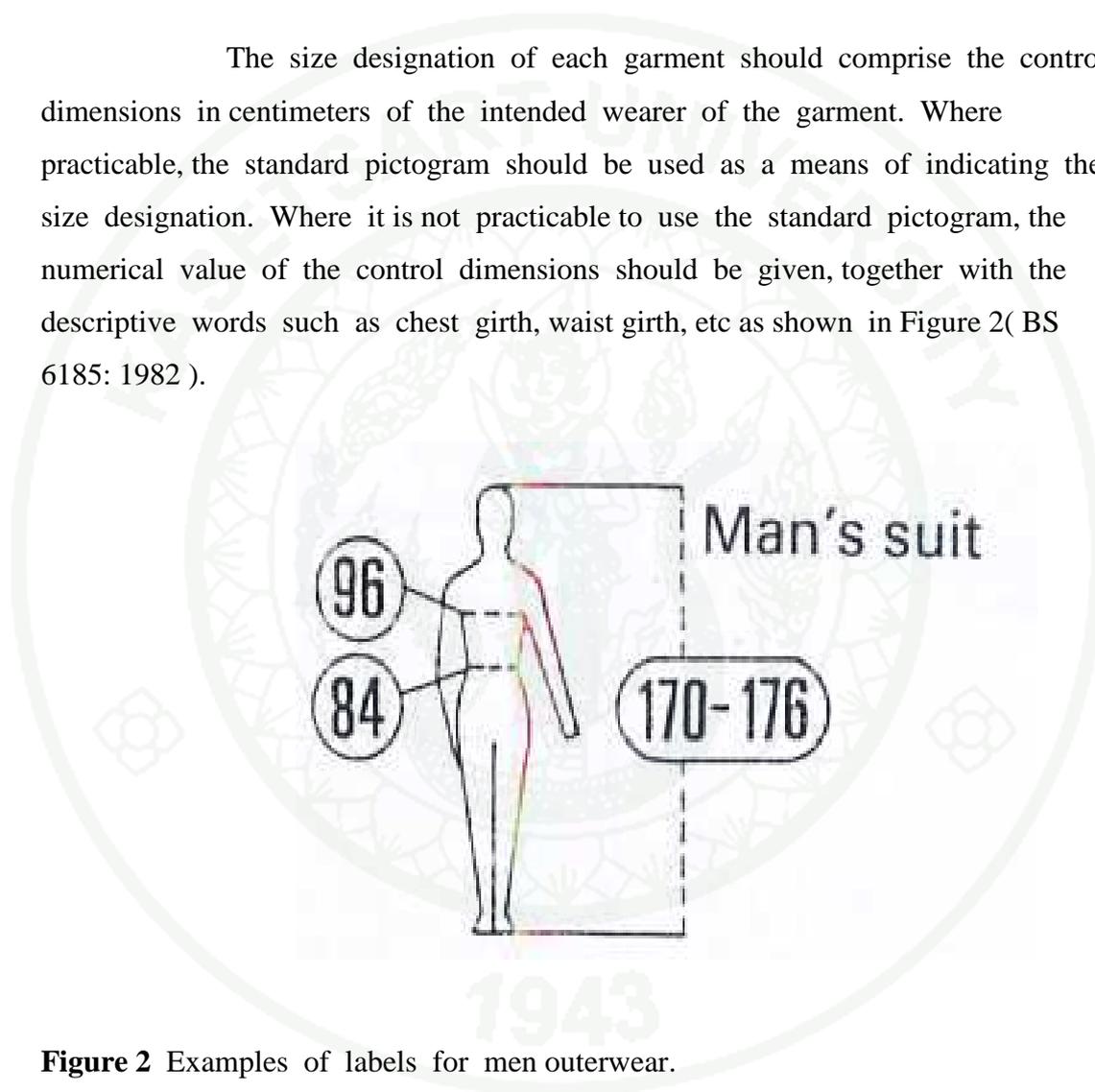


Figure 2 Examples of labels for men outerwear.

Source: Winifred (1990)

Any examination of men's garments in retail outlets in 1989 shows clearly that the recommendations on sizing and labeling, particularly the pictogram, have not been accepted with any enthusiasm by manufacturers. Most British garment sizing is still based on the imperial system (two inch size intervals). The multiple retailers are size labeling in inches but including translated metric equivalents.

Continental garments on sale in Britain follow the sizing system discussed earlier, but label the garments at half the full measurement: i.e. size 50=100 cm chest. The move towards a European Market in 1992 may provide the impetus to adopt the 1980 recommendations.

Manufacturers' product sample garments are used to show to buyers. The sample size will depend on the type of market at which the design is aimed. The sample size of suits and casual wear is usually based on the 100 cm chest size and the 39 cm or 40 cm neck (collar) size for shirts. The sample size of high fashion suits and shirts aimed at the very young man is usually 96 cm. chest size and 38 cm or 39 cm (collar) size for shirts. The medium size in casual wear will vary between 96 cm and 100 cm chest depending on its market.

The body sizes of woman and man use a pictogram, and the control measurements should be given, together with the descriptive words such as bust girth, hip girth etc, as shown in Figure 3 (Winifred, 1992).

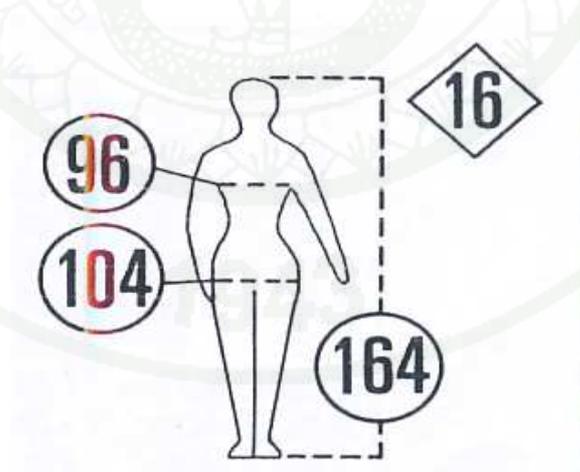


Figure 3 Examples of inclusion of women size code number into label.

Source: Winifred (1992)

ASTM (American Society for Testing and Materials) Standard sets of body measurements relate to figure types and serve as the basis for the numbered sizing of apparel. ASTM is currently working to update the standard tables of body measurements on which apparel sizes are based. Recently the first database of body measurements ever collected for women aged 55 and older (all figure types) was completed and published. Body measurement standards for infants 0-24 months, children sizes 2 to 6X or 7 have been updated, and tables for the “average women” figure now depict only the measurements and proportions currently used by the U.S. apparel industry to produce sizes 2 to 20. ASTM is currently soliciting funds for a body measurement study to update all body measurement of women 18 to 55 years of age. While work is in progress, it will take considerable funding and several years to update all body measurement tables. The men body sizes are three types: men, teen boys and boys and women body sizes are seven types: young junior/ teen, junior petite, junior, miss petite, miss, half-size and women (Armstrong, 2000).

C. Numbered sizing: Numbered sizing is the most common method of sizing for the majority of mass produced clothing, especially tailored and traditional clothing. Men’s and women’s sizing, while both numbered, are based on different systems. Men’s clothing sizes are stated in terms of body measurements while women’s clothing sizes and most children’s clothing sizes are stated in numbers that correlate to a set of body measurements. The associated body measurements for women’s wear and children’s wear are usually not published, the exceptions being measurement tables in some catalogs, height, weight charts on hosiery packages and some children’s wear labels. Moderate and expensive clothing tends to be sized using numbers. For example, many belts are sold by lettered sizing although better belts still tend to be sold by numbered size (representing waist measurement, usually in 2” increments) as shown in Table4.

Table 4 Women's wear and men's wear sizes.

Women's wear size	Men's wear size
(Correlate with bust, waist and hip measurements):	- Jackets (correlate with chest measurements and height):
- Misses figure type: 6 8 10 12 14 16 18 20 22	32 34 36 38 40 42 44 46 48 50 (Short, Regular or Long)
- Women figure type : 14 16 18 20 22 24	- Pants (correlate with waist and Inseam measurement) 32, 33, 34, 36, 38, 40 waist/ 29,30,31,32,33,34 inseam
- Junior figure type: 3 5 7 9 11 13 15 17	- Shirts (correlate with neck and sleeve length measurements) 14 ½, 15, 15½, 16, 16 ½, 17 neck/ 30, 31, 32, 33, 34 sleeve length

Source: Brown and Rice (2001)

Lettered sizing has grown increasingly popular in recent years. The stretch provided by knit fabrics and the popularity of loose fits have encouraged this trend. Lettered sizing uses the size designations of S= Small, M = Medium, and L = Large. It usually includes the extension XL = Extra large, sometimes XXL and XXXL for yet larger sizes and XS = Extra small. Collapsing sizing categories into lettered sizes reduces the number of size divisions from seven or eight to just three or four, a move retailers like because it reduces inventory and simplifies display of merchandise on the sales floor. However, consumers cannot find an accurate fit within S, M, L, and XL as easily as they can within numbered sizes, which provide finer differences among sizes. Even

hats and gloves, which were once sold almost exclusively by numbered sizes that equated with head and hand measurements, are mostly sold today by lettered “XS, S, M, L, XL” sizing.

Lettered sizing is prevalent in low – price lines because it eliminates the need for precise sizing and because it is most economical to produce fewer sizes. Foreign manufacturers who have difficulty in achieving accurate sizing for the U.S. market turn to lettered sizing because of its simplicity. Many retailers like lettered sizing because, by eliminating the need to carry so many sizes, it allows them to carry a greater number of styles and colors. Consumers easily identify with lettered sizing, although it often gives them little real assistance in finding a garment that fits; S, M, L, and XL have little standardization from brand to brand and no consistent correlation to body measurement. In fact, S, M, L, and XL are used without any differentiation for unisex garments, men’s wear, women’s wear, and children wear.

Sometimes garment length is also designated with lettered sizing. When they do not provide length in inches, manufacturers commonly use P = Petite or S = Short, A = Average or R = Regular, and L = Long or T = Tall. When lettered sizing is used internationally, it provides little information to consumers in another country unless it is designed with the foreign market in mind. For example, the average “small” person in the United States or Europe is significantly larger than the average “small” person in Asia.

One-size-fits-all sizing is an attempt by manufacturers and retailers to further collapse sizing by providing garments that have the ability to stretch to fit many figure types and sizes. But one-size-fits-all apparel cannot be expected to accurately fit figure types at either size extreme. Perhaps the more accurate label for these garments is “one-size fits-most.” A good example is socks for adult men and women. Standard socks fit most people, but people wearing the smallest and largest shoe sizes do not get an ideal fit.

D. Standard body measurements Successful manufacturers and retailers spend a great deal of time and effort perfecting the sizing and desired fit for their target market customers. They conduct marketing studies to learn not only the buying habits of the target customers but their approximate sizes, shapes, and fit preferences. They use these data to design garments that suit the sizing (classification of the dimensions of garments) and fit needs of the target customers. For example, the target customer might be a woman between the ages of 25 and 35 with young children and a full – time job. The marketing data indicate that she prefers loose, comfortable clothing that is easy to care for; she is less than 5 '4 "tall , and her weight is between 120 and 150 pounds. With this particular customer in mind, the designers plan basic blocks that are short in length but large in girth dimensions. The silhouettes will be loose on the body and made in cotton blend or synthetic easy – care fabrics.

A real – life example of unique fit success is Lee Company's women's jeans line. Historically, women wear, men's jeans and struggled with the slim hips and large waists. When women began to wear pants on a frequent basis, design personnel at Lee Company recognized that women's body shapes were different from men's and women should have jeans that comfortably fit their body shape. So instead of using a men's basic block and converting it to a women's size, research was conducted on the differences between a men's and a women's body shape. Original basic blocks for jeans were then developed specially for the woman body shape. This resulted in a well- fitting women's jean that continues to impact the way women's jeans fit today (Brown and Rice, 2001).

The standard body measurements for men have description of body such as chest, seat, waist, low waist, half back, natural waist length, skye depth, neck size, sleeve length (two piece), inside leg, body rise, close wrist measurement, cuff size (two piece), trouser bottom, jeans bottom, neck and cuff for shirts and sizes chart (Figure 4 and Table 5).

The standard body measurements for women have description of body such as bust, waist, hips, top hips, back width, chest width, shoulder, bust separation, neck-base, rib-cage chest, top arm, elbow, wrist, thigh, knee, ankle, nape-waist, nape-bust, nape-armhole depth, nape-ground, bust height, top sleeve length, waist & knee, waist knee, waist floor, full height, body rise, crutch length and sizes chart (Figures 5,6 and Table 6). The samples of international standard sizes are shown in Table 7-18: Germany men (Table 7), USA men (Table 8), Japanese men (Table 9) Holland women (Table 10), Canada women (Table 11), Israel women (Table 12), Australia women (Table 13), USA women (Table 14) England women (Table 15), France women (Table 16) West Germany women (Table 17) and Japanese women (Table 18).

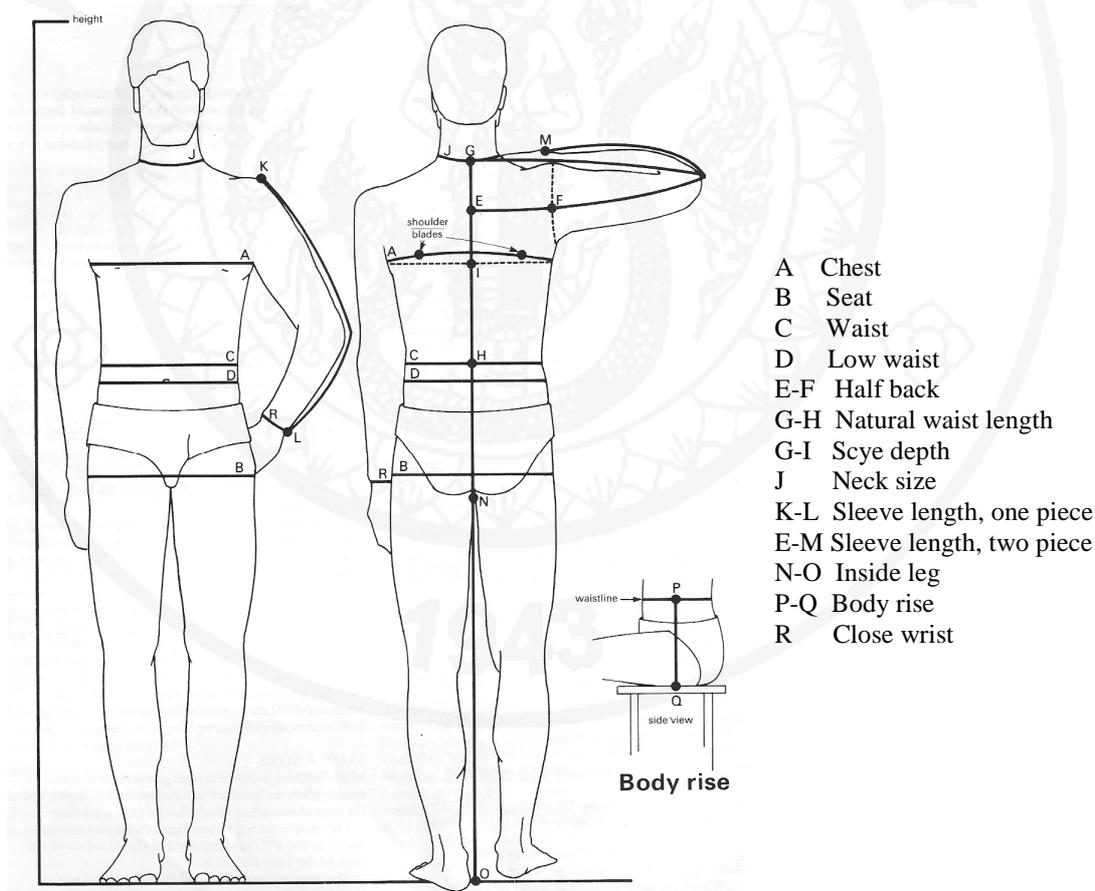


Figure 4 Body measurements for men's size.

Source: Winifred (1990)

Table 5 Sizes charts for men. (height 170 cm – 178 cm or 5 ft 7 in – 5 ft 10 inch)

Measurement	Sizes (centimeters)								
	44	46	48	50	52	54	56	58	60
A Bust	88	92	96	100	104	108	112	116	120
B Seat	92	96	100	104	108	114	118	122	126
C Waist	74	78	82	86	90	98	102	106	110
D Low waist	77	81	85	89	93	100	104	108	112
E-F Half back	18.5	19	19.5	20	20.5	21	21.5	22	22.5
G-H Natural waist length	43.4	43.8	44.2	44.6	45	45	45	45	45
G-I Scye depth	22	22.8	23.6	24.4	25.2	26	26.4	26.8	27.2
J Neck size	37	38	39	40	41	42	43	44	45
K-L Sleeve length, one piece	63.6	64.2	64.8	65.4	66	66	66	66	66
E-M Sleeve length, two piece	79	80	81	82	83	83.5	84	84.5	85
N-O Inside leg	78	79	80	81	82	82	82	82	82
P-Q Body rise	26.8	27.2	27.6	28	28.4	28.8	29.2	29.6	30
R Close wrist	16.4	16.8	17.2	17.6	18	18.4	18.8	19.2	19.6
Cuff size ,two-piece	27	28	29	30	31	31.6	32.2	32.8	33.4
Trouser bottom	23.5	24	24.5	25	25.5	26	26	26	26
Jeans bottom	20.5	21	21.5	22	22.5	23	23	23	23
Neck (collar size)	37	38	39	40	41	42	43	44	45
Cuff size for shirts	22	22.5	22.5	23	23	23.5	23.5	24	24

Source: Winifred (1990)

Horizontal Measurements

- (1) Bust
- (2) Waist
- (3) Hips
- (4) Top hips
- (5) Back width (X back)
- (6) Chest width
- (7) Shoulder
- (8) Bust separation
- (9) Neckbase circumference
- (10) Rib cage
- (11) Chest circumference
- (12) Top arm
- (13) Elbow
- (14) Wrist
- (15) Thigh
- (16) Knee
- (17) Ankle

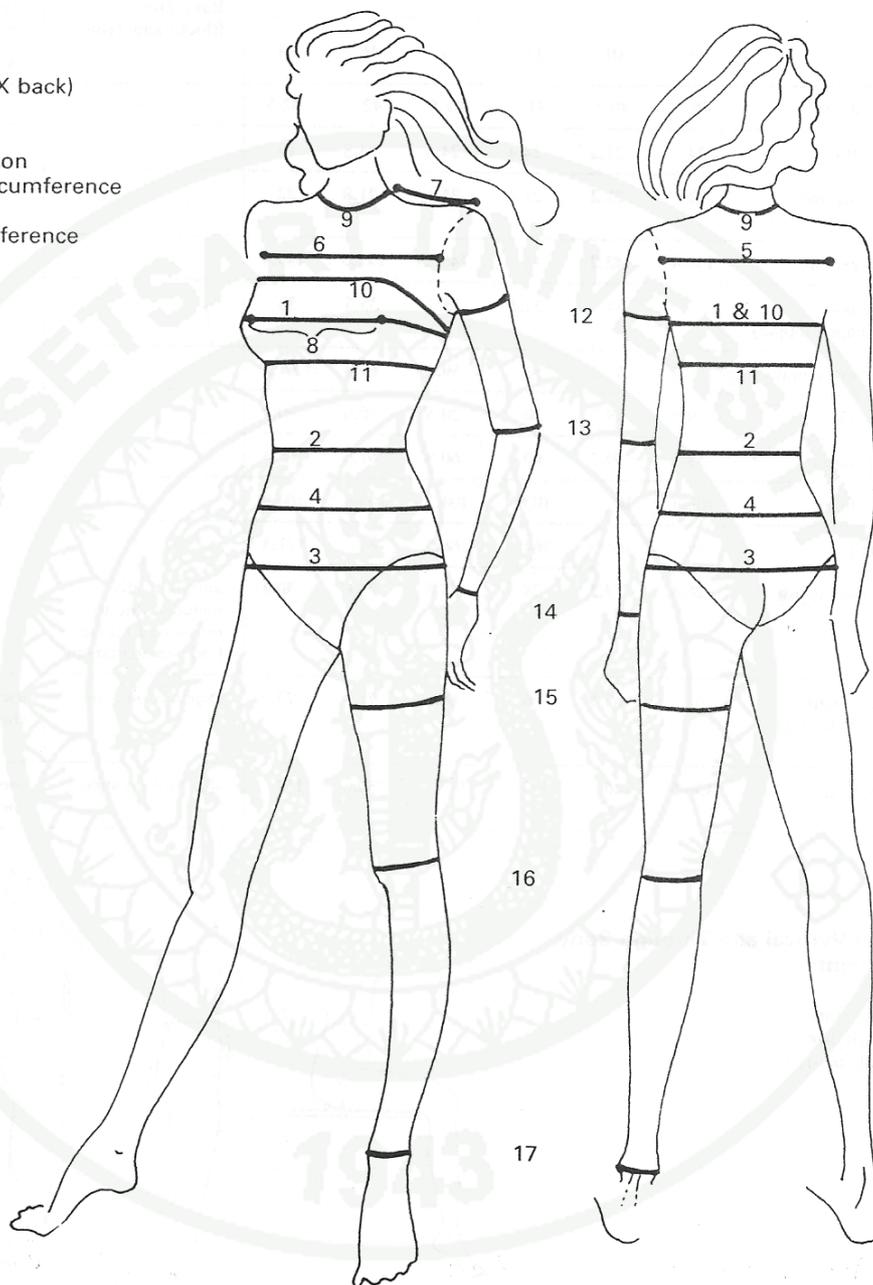


Figure 5 Body measurements for women's size (Horizontal).

Source: Haggard (1990)

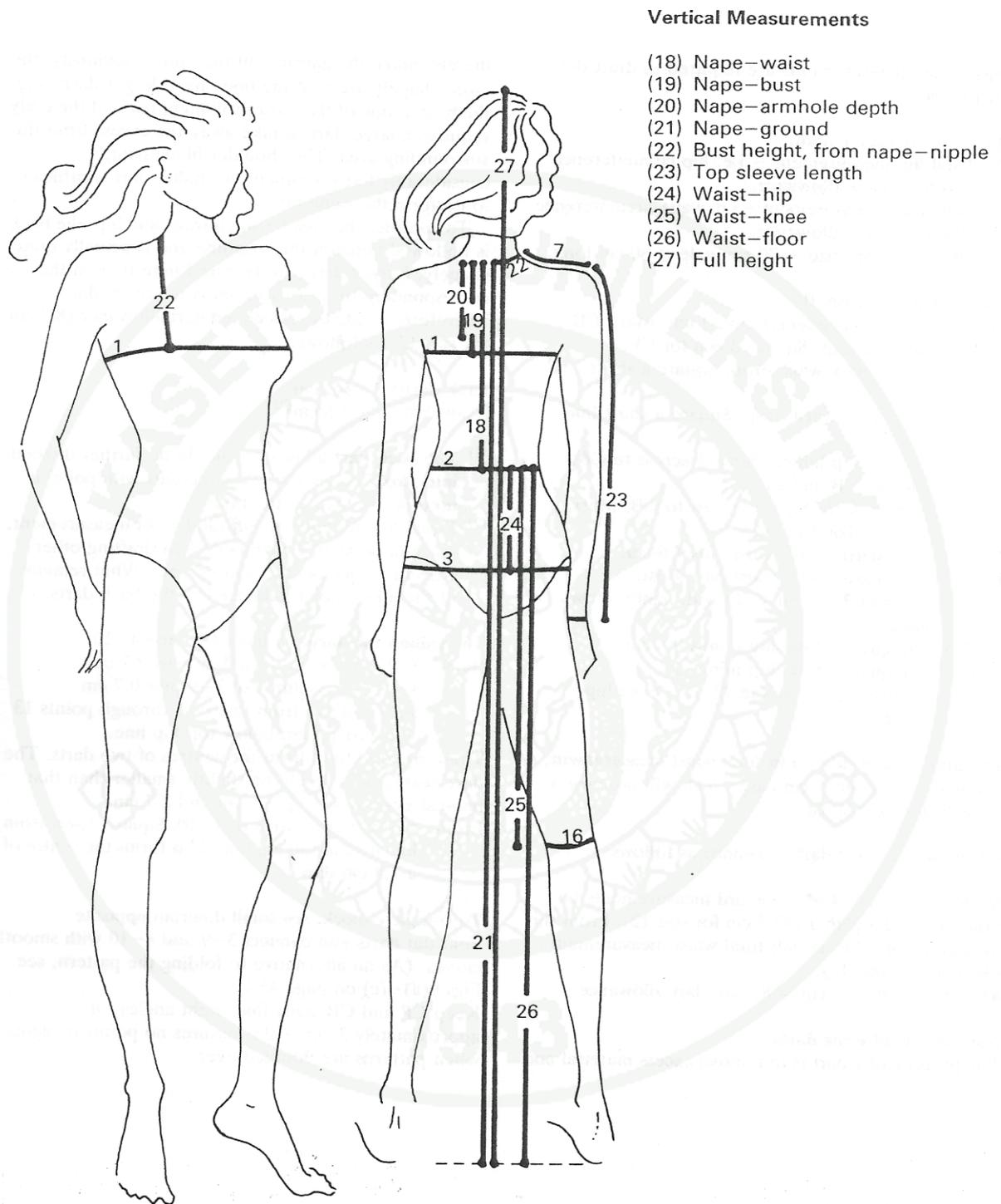


Figure 6 Body measurements for women's size (Vertical).

Source: Haggard (1990)

Table 6 Sizes charts for women.

Measurement	Sizes (centimeters)						Body plus
	8	10	12	14	16	18	Size 12
1. Bust	80	84	88	92	96	100	98
2. Waist	60	64	68	72	76	80	69
3. Hips	86	90	94	98	102	106	99
4. Top hips	80	84	88	92	96	100	92/93
5. Back width	34	35	36	37	38	39	37.6
6. Chest width	31.5	32.5	33.5	34.5	35.5	36.5	34.1
7. Shoulder	12.4	12.7	13	13.3	13.6	13.9	13
8. Bust	16.8	18	19.2	20.4	21.6	22.8	19.2
9. Neck-base	35.5	36.5	37.5	38.5	39.5	40.5	37.5
10. Rib-cage	74	78	82	86	90	94	82
11. Chest	67	71	75	79	83	87	75
12. Top-arm	26	27	28	29	30	31	33
13. Elbow	22.2	23.6	25	26.4	27.8	29.2	25
14. Wrist	15	15.5	16	16.5	17	17.5	22.5
15. Thigh	48	51	54	57	60	63	54
16. Knee	32.2	33.6	35	36.4	37.8	39.2	35
17. Ankle	21.8	22.4	23	23.6	24.2	24.8	23
18. Nape-waist	40	40.5	41	41.5	42	42.5	41
19. Nape-bust	24	24.2	24.4	24.6	24.8	25	24.4
20. Nape-armhole	21	21.2	21.4	21.6	21.8	22	21.4
21. Nape-ground	140.4	142.2	144	145.8	147.6	149.4	144
22. Bust - nope nipple	33.5	34	34.5	35	35.5	36	34.5
23. Top sleeve length	56.4	57.2	58	59.6	60.4	61.2	58
24. Waist & knee	19.4	19.7	20	20.3	20.6	20.9	20
25. Waist	58.4	59.2	60	60.8	61.6	62.4	60
26. Waist & floor	100.4	101.7	103	104.3	105.6	106.9	103
27. Full height	159	161.5	164	166.5	169	171.5	164
28. Body rise	26.4	27.2	28	28.8	29.6	30.4	28
29. Crutch length	61	63.5	66	68.5	71	73.5	66
30. Trunk length	136.5	140	143.5	147	150.5	154	143.5

Source: Haggar (1990)

Table 7 Size chart of Germany - medium height men (for regular fitting covergarment).

Measurement	Sizes (centimeters)							
	44	46	48	50	52	54	56	58
1 Height	168	171	174	177	180	182	184	186
2 Bust girth	88	92	96	100	104	108	112	116
3 Waist girth	76	80	84	88	92	98	102	108
4 Hip girth	96	100	104	108	112	116	119	122
5 Across back	37	38	39	40	41	42	43	44
6 Back waist length	42	43	44	45	46	46.5	47	47.5
7 Outside leg	98	100.5	103	104.5	106	107.5	109	110.5
8 Inside leg	74	76	78	79	80	81	82	83

Source: Cooklin (1992)

Table 8 Size chart of USA- medium height men.

Measurement	Sizes (centimeters)					
	36	38	40	42	44	46
1 Bust girth	91	96	101	106	111	116
2 Waist girth	81	86	91	96	101	106
3 Hip girth	101	106	111	116	121	126
4 Wrist girth	30	31.2	32.2	33.2	34.2	35.2
5 Across chest	25.1	26	26.9	27.8	28.7	29.6
6 Shoulder length	15.8	16.1	16.4	16.7	17	17.3
7 Arm length	61.4	62.6	63.8	65.2	66.4	67.6

Source: Cooklin (1990)

Table 9 Size chart of Japan - height men.

Measurement	Sizes (centimeters)						
	42R	44R	46R	48R	50R	52R	54R
1 Height	160	160	160	160	160	160	160
2 Bust girth	82	84	88	92	96	100	104
3 Waist girth	55.6	58.6	61.8	65.2	68.8	72.6	72.6
4 Hip girth	75	79	83	87	91	95	99
5 Across back	33	33.5	34	35	36	37	38
6 Back waist length	37	37.3	37	38	38.5	39	39.5

Source: Anonymous (1995)

Table 10 Size chart of Holland - varying height average bust women.

Measurement	Sizes (centimeters)										
	34	36	38	40	42	44	46	48	50	52	
1 Height	152- 157	156- 161	160- 165	164- 169	167- 173				Not given		
2 Bust girth	92	95	98	101	104	108	112	120	128	136	
3 Waist girth	64	68	72	76	80	84	88	96	104	112	
4 Hip girth	98	100	103	106	110	114	118	124	132	140	
5 Across back	Not given										
6 Back neck waist	35.5	37.5	39.5	41.5	43.5			Not given			

Source: Cooklin (1990)

Table 11 Size chart of Canada - short waist short leg women.

Measurement	Sizes (centimeters)									
	10 ^{1/2}	12 ^{1/2}	14 ^{1/2}	16 ^{1/2}	18 ^{1/2}	20 ^{1/2}	22 ^{1/2}	24 ^{1/2}	26 ^{1/2}	28 ^{1/2}
1 Height	154	154	154	154	154	154	154	154	154	154
2 Bust girth	86	90	94	99	104	109	114	119	124	129
3 Waist girth	67	71	76	82	88	94	99	105	111	117
4 Hip girth	86	91	96	101	106	111	116	121	126	131
5 Across back	32.8	33.8	34.5	35.6	36.8	37.8	39.1	40.1	41.1	42.4
6 Back waist length	38.9	39	39.1	39.4	39.7	39.7	39.9	40.1	40.3	40.3

Source: Cooklin (1990)

Table 12 Size chart of Israel - dynamic height average bust women.

Measurement	Sizes (centimeters)					
	36	38	40	42	44	46
1 Height	160	162	164	166	168	170
2 Bust girth	84	88	92	96	100	104
3 Waist girth	65	67	70	74	78	82
4 Hip girth	90	94	98	102	106	110
5 Across back	31.6	32.7	33.8	34.9	36	36.8
6 Back waist length	40	40.5	41	41.4	42	42.5

Source: Cooklin (1990)

Table 13 Size chart of Australia - average women.

Measurement	Sizes (centimeters)									
	8	10	12	14	16	18	20	22	24	26
1 Height	160	161	163	164	165	166	168	168	169	169
2 Bust girth	75	80	85	90	95	100	105	110	115	120
3 Waist girth	55	60	65	70	75	80	85	90	95	100
4 Hip girth	80	85	90	95	100	105	110	115	120	125
5 Across back	30	31	32	33	34	35	37	38	39	40
6 Back waist length	38	39	39	40	40	41	41	42	42	42

Source: Cooklin (1990)

Table 14 Size chart of USA - regular height women.

Measurement	Sizes (centimeters)							
	6	8	10	12	14	16	18	
1 Bust girth	86.5	89	91.5	95	99	103	108	
2 Waist girth	61	63.5	66	70	74	77.5	82.5	
3 Hip girth	90	93	95	99	103	107	112	
4 Across back	34	35.5	36	37	38	39	40	
5 Back waist length	42.5	43	44	44.5	45	46	47	

Source: Armstrong (2000)

Table 15 Size chart of England - medium height women.

Measurement	Sizes (centimeters)						
	10	12	14	16	18	20	22
1 Height	160	161.9	162.6	163.2	163.2	163.9	170
2 Bust girth	82	84	88	92	97	102	107
3 Waist girth	60	64	68	72	77	82	87
4 Hip girth	85	89	93	97	102	107	112
5 Across back	32.4	33.4	34.4	35.4	36.6	37.8	39
6 Back waist length	39	39.5	40	40.4	41	41.5	42

Source: Winifred (1992)

Table 16 Size chart of France - medium height women.

Measurement	Sizes (centimeters)						
	80	84	88	92	96	100	104
1 Height	160	160	160	160	160	160	160
2 Bust girth	80	84	88	92	96	100	104
3 Waist girth	58.6	61.8	65.2	68.8	72.6	76	80.7
4 Hip girth	84	88	92	96	100	104	108
5 Across back	32.4	33.9	35.2	36.2	37.1	37.9	38.6
7 Back waist length	39.7	39.7	39.7	39.7	39.7	39.7	39.7
8 Weight : Kg	37.9	45.4	51.6	56.7	61.1	65	68.5

Source: Cooklin (1990)

Table 17 Size chart of West germany - regular height women.

Measurement	Sizes (centimeters)					
	36	38	40	42	44	46
1 Height	168	168	168	168	168	168
2 Bust girth	84	88	92	96	100	104
3 Waist girth	66	70	74	78	82	86
4 Hip girth	91	94.5	98	101.5	105	108.5
5 Across back	34.5	35.5	36.5	37.5	38.5	39.5
6 Back waist length	41	41.2	41.4	41.6	41.8	42
7 Weight : Kg	53	57	61	65	69	73

Source: Cooklin (1990)

Table 18 Size chart of Japan - women.

Measurement	Sizes (centimeters)					
	7	9	11	13	15	17
	(S)	(M)	(ML)	(L)	(LL)	(3L)
1 Height	158	158	158	158	158	158
2 Bust girth	78	82	88	94	100	106
3 Waist girth	62	66	70	76	80	90
4 Hip girth	88	90	94	96	102	112
5 Across back	33	34	35	36	37	38
6 Back waist length	37	38	39	40	41	41

Source: Anonymous (2003)

2. Model Construction

The human form has been used as a subject by sculptors since prehistoric times and interpreted in a variety of ways, using whatever materials available. There are many elements required to do sculpture. The three primary ones are time, material and inclination (Slobodkin, 1973). However, there are factors of building a sample model as follows:

A. Materials More than any other art medium, sculpture requires a special understanding of, and excitement for, materials. The basic techniques and principles of carving, modeling and metal – casting in use today have not changed from the days when they were employed by ancient civilizations. The greatest sculptors have been those who have had respect for, and an appreciation of, the inherent qualities of their materials. These materials can be as diverse as stone, clay, plaster, metal, paper, soap and even glitter. The main materials with which we shall be working that require some degree of technical tutoring are clay and plaster.

Clay was traditionally dug directly from the earth and then modeled into shape before being fired at a high temperature to strengthen it and make permanent forms that can last for thousands of years. However, in order to work with traditional clays, ranging from porcelain through terra cotta to stoneware, you must have access to a kiln. Although community colleges that offer evening classes in ceramics often allow people to fire work in their kilns, so many synthetic clays (which can either be fired in a kitchen cooker or simply left to dry) are now available from most art suppliers that there is no longer any need to undertake the problematic process of firing traditional clay.

Plaster is most commonly used for replication purposes, such as the reproduction of Greek and Roman statues. Plaster can however, be used as a material in its own right: when cast into a block, for instance, it makes a cheaper alternative to stone that is also much easier to carve. Because it reacts over time with the moisture

C. Basic techniques

1. Sculpture or modeling

The process of modeling is one in which the form is built up using a malleable material, such as clay or wax, which gives the sculptor much greater freedom because one can add or subtract material to the form, enabling any mistakes to be amended or rebuilt. When modeling a large form, the sculptor may sometimes create an armature, a rigid, internal skeleton (usually made of wood or metal) that helps to support the malleable material if it cannot bear its own weight. The armature's form must, of course, itself be carefully considered because it will strongly determine the form of the finished sculpture. Another important consideration when modeling is surface texture because it is important to take advantage of the pliability of the materials with which you are working. Modeling provides the sculptor with a more direct and spontaneous form of expression than carving or construction and is usually the route into the medium for most sculptors (Figure 8).

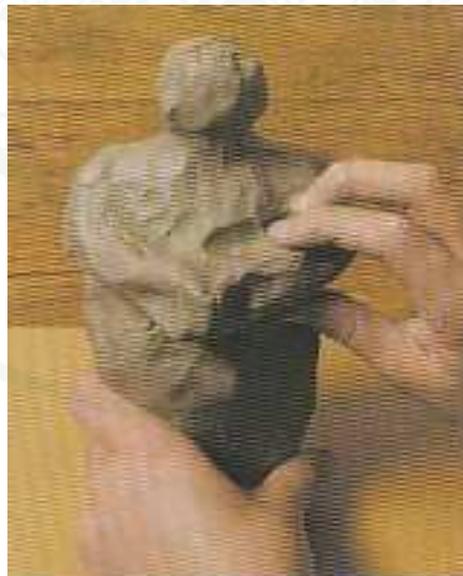


Figure 8 Modeling.

Source: Leaper (2003)

2. Carving

Carving is essentially a subtractive process whereby the sculptor chisels, cuts and chips the outer surface of a solid block of wood or stone to varying depths in order to create a sculpture. Carving was traditionally created from stone, such as marble, granite, limestone and sandstone. These materials, particularly marble, are extremely hard and require a great degree of patience to sculpt (during the Renaissance period, a life – sized sculpture of a person would take many years to carve). Because it relies on extensive planning and technical ability, carving is perhaps the most difficult and laborious way of creating a sculpture, and if you make a mistake whilst carving, you cannot return what you have taken away (Figure 9).



Figure 9 Carving.

Source: Leaper (2003)

3. Casting

Casting was traditionally used solely as a method of reproducing or mass – producing existing sculptures in a more permanent material, transforming, for example, a wax sculpture into bronze or one of unfired clay into plaster. The two traditional sculpting techniques that use casting are, firstly, the lost – wax method for casting bronze and secondly, sand casting. The lostwax process involves making a sculpture in wax, which is then covered in plaster. This is fired at a high temperature so that the wax melts and runs out, leaving a hollow, negative cavity where the original wax sculpture once was. Molten bronze is then poured into the plaster and left to set, after which the plaster is chipped off, leaving an exact bronze replica of the original wax sculpture. Small models may be cast as solid sculptures, but larger ones usually require a more complicated casting process. Sandcasting involves making negative, imprinted sections of the outside of the chosen object and then reassembling the segments and pouring in plaster to produce an identical version of the original object (Figure 10).



Figure 10 Casting.

Source: Leaper (2003)

4. Papier – mache portraying

Portraiture has been an enduring theme in sculpture for thousands of years, ranging from the mummy coffins of ancient Egyptian kings through the highly colour busts of Greek notaries and eminent philosophers to the marbles of the Renaissance and the abstract clay sculptures of contemporary artists. Almost all of the great sculptors over the years have either explored the theme of self – portraiture or have been commissioned to sculpt portraits of their patrons or friends. Firstly, although sculptural portraits were traditionally made out of such durable materials as marble or bronze to act as enduring memorials to their subjects, we will be using papier – mache, a light – weight, non – durable material that enables more flexibility when sculpting. Secondly, although it is traditionally the norm for portraits to be the colour of the material that was used to make them, such as brown in the case of bronze or white in that of marble, it is commonly thought that the ancient Green marble sculptures that today appear purely white were actually brightly painted when they were first made as shown in Figure 11 (Leaper, 2003).



(a)

(b)

Figure 11 Papier – mache portraying (a)covering paper on sculpture and
(b) glue painting.

Source: Leaper (2003)

D. Modeling a figure from life : The men's figure has a broad – shouldered, flat upper torso that wedges into his narrow hips. The women's upper torso (exclusive of the volume of the breasts) is comparatively small and wedges into her broad hips. The women's breasts are built on the shape of the thorax (rib basket). The men's breast shapes lie like flat square flakes on its thorax. The thigh shapes on both figures do not end at the crotch but continue up on both figures on either side of the lower wedges of the torsos. Both men's and women's thighs are full – shaped, front, inner thighs and back but the outer sides of both their thighs tend toward flat shapes. The thigh shape on both men and women does not end at the kneecap. It continues down and includes the whole knee joint in its overall shape. The lower legs of the men are harder and scrawnier than the flowing women's lower leg. The feet are wedge – shaped (Figure 12).

The arms of both men and women are attached and pivot, and swing free at the shoulder the way a doll or manikin's arms do. The men is naturally stronger and harder shaped than the women. The back of the upper torso of both men and women tends to be flat and is planned as indicated in the drawing. Although it is said that a man should stand firmly on his own feet (legs), the true structural base of a human figure is the pelvis. The legs sprout from the pelvis and so does the rest of the torso and from the torso grow the arms, neck and head. The torso with its pelvic base is like a tree trunk. The arms, neck and head are upper branches; the legs and feet are strong roots. If the branches or roots are smashed up a bit the figure (the tree) still functions. But a broken pelvic shape ruins a figure completely as shown in Figures 13 and 14 (Slobodkin, 1973).

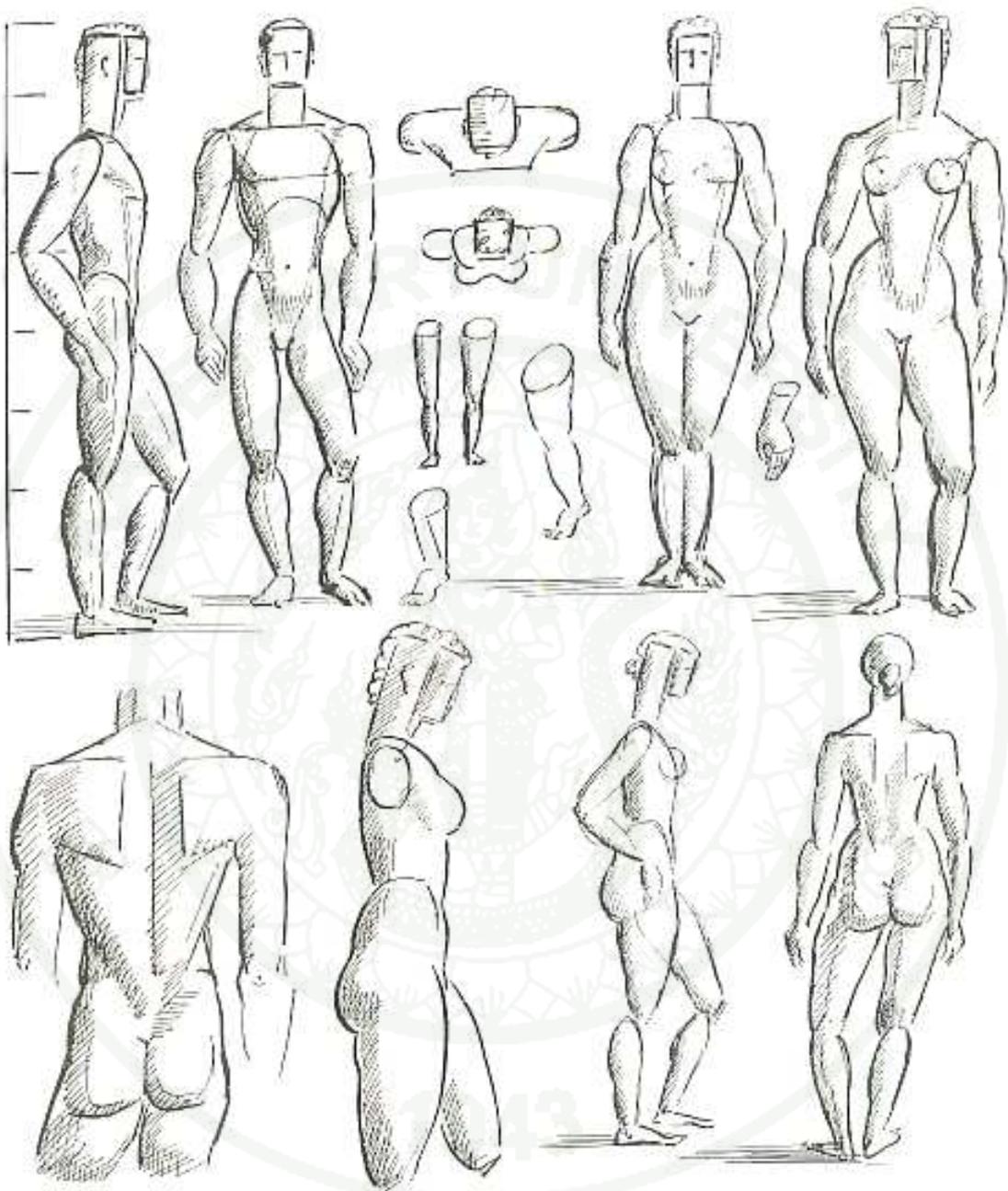


Figure 12 Men and women structure.

Source: Slobodkin (1973)



Figure 13 Men model.
Source: Slobodkin (1973)

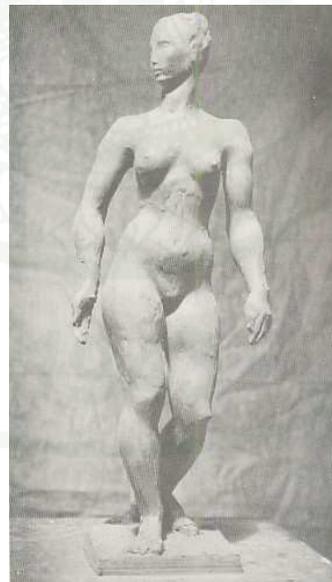


Figure 14 Women model.
Source: Slobodkin (1973)

Standard size models are tools for patternmaking and fitting. There are men models and women models (Figure 15 and 16). Both of them have half – length and full length versions (Figures 17 and 18). The standard size models are used to made body sculpture by using papier - mache techniques. The modeling stand is made from wood or metal. After that, the shell fabrics and interlining fabrics will be used to cover on the model.



Figure 15 Britain's men model.

Source: Cooklin (1992b)

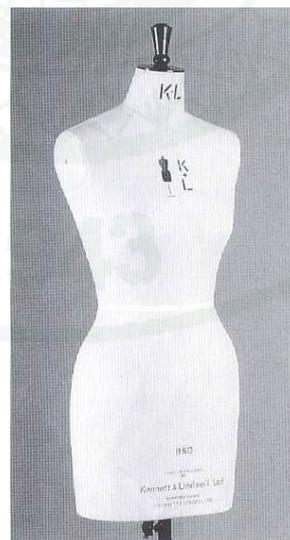


Figure 16 Britain's women model.

Source: Kennett and Lindsell (1998)



German form

Figure 17 Germany's half-length men model.

Source: Cooklin (1992b)

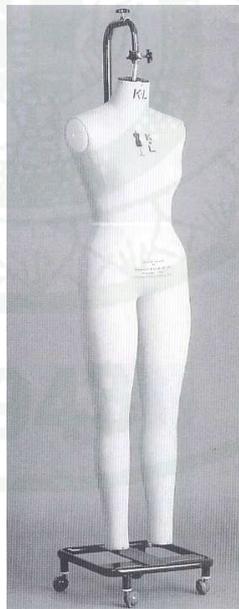


Figure 18 Britain's full-length women model.

Source: Kennett and Lindsell (1998)

3. Materials for model construction

Most models are made from shell and underlining fabrics. Most of the shell fabrics are woven cotton and woven linen, while the interlining fabrics are nonwoven materials. However, the fabrics for models should have the best qualification such as bursting strength, tensile strength, ease of punching a pin on and tightness of pin on the models. The textile materials have lot of description as follows:

Fibers are the hair like raw materials that are spun into yarns and then made into fabric. Fiber characteristics such as fineness, moisture regain, elasticity, luster, or crimp are inherent and therefore affect the properties of yarns and fabrics (Frings, 1996). Fibers are the raw materials from which fabrics are made; they are the basic building blocks of a fabric. An individual fiber is a fine, hair like structure. Knowing the fiber content of a fabric helps predict the aesthetic and functional performance of the fabric and the garment. The type of fiber or fibers from which a fabric is produced strongly influences the fabric's characteristics.

Fiber content affects the aesthetics, comfort, durability, shape and appearance retention, ease of care and other performance characteristics as well as the cost of the fabric. For example, fibers affect the hand of the fabric, including its texture and drape, because some fibers are inherently soft and other are stiff. Fiber content also affects the dimensional stability of the fabric. For example, wool fibers have a tendency to stretch and to shrink under warm, wet conditions. Other fibers, such as nylon, have the ability to return to their original length after being stretched, which improves the dimensional stability of nylon fabrics. A fiber with high abrasion resistance contributes to the durability of the fabric. Comfort factors such as the absorbency, moisture transmission and retention, water repellency, air and thermal retention, and electrical conductivity of a fabric are greatly affected by the properties of the fibers used to make the fabric. The luster of the fiber influences the luster of the fabric. Some fibers are fuzzy, making them likely to hide soil and to retain trapped soil, affecting the appearance and ease of care of the fabric. In

addition to influencing fabric performance, fiber content is listed on the label of the garment and therefore affects the consumer's perception of quality.

A. Natural fibers Fiber falls into two broad categories : natural fibers, which occur naturally in the environment, and manufactured fibers (Brown and Rice, 2001). The natural fibers used in apparel include:

1. Protein fibers: Silk, wool, and other fibers from animal sources
2. Cellulosic fibers: Cotton, linen, and its close relatives ramie and hemp and other fibers from plant sources. In general, natural fibers are more costly and considered to be more luxurious than manufactured fibers. Consumers typically associate natural fibers with comfort, durability and beauty.

Cotton and flax are the major natural plant or vegetable fibers used in the creation of apparel and accessories. Others such as hemp, ramie and jute are also found in garments but to lesser extents. Wool, cashmere, alpaca, vicuna, camel's hair, angora and mohair are animal fibers, of which wool is the most widely used. Silk, although taken from the shell or cocoon of the silkworm, is also classified as an animal fiber because it is primarily made up of the secretions of the worm (Diamond, 1994).

Some of the cotton fabrics that are found in apparel and accessories include: broadcloth, chambray, corduroy, denim, jersey, oxford, plisse, sateen, seersucker, terry cloth, velour, velvet and velveteen. Flax is a gold colored, straw like plant whose stems are used for fiber. The flax is now ready for production into linen, the name given to fabrics made from flax.

The only distinct disadvantage associated with the fiber is its tendency to wrinkle and, when laundered, it is difficult to press. When it is blended with polyester, however, it becomes a product that requires little or no ironing. Some of

the types of linen used in apparel and accessories include art linen, cambric, canvas, crash, damask, handkerchief, linen and lawn.

There are two major classifications for wool yarns and fabrics, woolens and worsteds. Woolen fabrics are characterized as being fuzzy, thick, and bulky and are made from shorter fibers that have been carded. Worsted yarns are spun from longer staples that have first been carded and then combed, which further straightens the fiber and drawn, which brings it to a thinner, more uniform diameter. Worsteds are crisper, smoother and lighter in weight than woolens. Some of the more popular wool fabrics are convert, crepe, donegal, felt, flannel, gabardine, herringbone, laden, serge, shetland and tweed.

Silk is the filaments or continuous fiber a silkworm spins for its cocoon. Unlike other natural fibers, which come in short or staple lengths and must be attached or spun to form yarn, a single silk filament ranges from 800 to 1,300 yards in length. Silk is used extensively for wearable products and comes in a variety of weights and textures. Some of those used in fashion apparel and accessories include alpaca, broadcloth, boucle, chiffon, crepe de chine, georgette, honan, point d' esprit, pout de soie, pongee, satin, shantung, sarah, taffeta and tussah (Diamond,1994).

B. Manufactured fibers Manufactured fibers or man- made fibers are formed through human effort. The manufactured fibers used in apparel include (Brown and Rice, 2001).

1. Regenerated cellulosic fibers made from plant fibers such as rayon, lyocell, acetate and triacetate.

2. Synthetic fibers made from petroleum products such as nylon, polyester, acrylic, modacrylic, olefin, and spandex.

3. Miscellaneous fibers such as rubber and metallic.

There are 12 major groups of man-made fibers, eight of which are found in considerable abundance in fashion apparel and accessories. Each has specific characteristics that are unique and are available under trade names that belong to their producers (Diamond, 1994).

Rayon: The first man-made fiber developed. Rayon is composed of regenerated cellulose derived from wood pulp, cotton linters, or other vegetable matters. The cellulose is dissolved into a viscose solution and spun into fiber. Rayon has become very popular because it is a soft, lustrous, versatile fiber that can be treated and finished to produce a wide range of characteristics.

Lyocell: Lyocell is the generic designation for a new solvent-spun cellulosic fiber developed by Enka and later sold to Cuortaulds, known commercially as Tencel. Lyocell is almost twice as strong as rayon, both wet and dry and is a good blending partner with cotton, wool, acetate and polyester. It takes color well and its hand can be altered to resemble silk or cotton. However, it is difficult to weave and finish and can develop pills.

Like rayon, lyocell is produced from wood pulp. However, lyocell is manufactured using a solvent-spinning technique in which the dissolving agent is recycled, thus reducing waste that is harmful to the environment.

Acetate and Triacetate: Acetate (diacetate) and triacetate have been adopted as less expensive alternatives to rayon as they are also soft and lustrous, although not quite as strong as rayon. Both are cellulose chains treated with acetic anhydride. However, only two-thirds of the chain is treated to produce diacetate. The entire chain is treated to produce triacetate. Then both kinds are dissolved in a solvent to make dry spinning possible.

Triacetate can be heat-set to give it easy-care properties, but it requires such strong solvents that it is no longer produced in the United States.

Diacetate can be dissolved in solvents that are easier to handle and therefore is more widely produced.

Nylon: One of the strongest and most durable man-made fibers, nylon is made of a long-chain synthetic polymer. Nylon filaments usually have an even, silky hand but can also be textured to produce a soft, supple hand. Nylon is not only strong but also flexible, washable and colorfast. In apparel, it is used primarily in hosiery, lingerie, bathing suits and active sportswear. The Italian designer Miuccia Prada has made nylon fabric fashionable.

Polyester: Another kind of long-chain synthetic polymer, polyester is the most widely used man-made fiber in the world. Chemical companies can produce polyester fiber in the forms of filament, staple, or tow (short or broken fiber).

Polyester is highly wrinkle resistant and easy to care for. It was one of the first fibers to be developed in fabrics with permanent-press features. It is often blended with natural fibers to lend easy-care properties to them. Polyester is used in many types of apparel, including textured knits and woven's, permanent-press blend fabrics, shirting's, suiting's and sleepwear.

Acrylic: Acrylic is yet another long-chain synthetic polymer. Because of the composition and cross section of the fiber, fabrics made of acrylic have a high bulk-to-weight ratio. This provides warmth in fabrics that are lightweight, soft and resilient. End uses of acrylic include knit wear, fleece active wear, suits, coats and fake furs.

Spandex: A long-chain synthetic polymer comprised of segmented polyurethane, spandex can stretch 300 to 400 percent without breaking and return to its original length. Its elastic properties are unequaled by any other fiber and it does not deteriorate as rubber does. Because of its tremendous stretch, spandex is generally combined in small percentages of 2 to 20 percent with other fibers

such as cotton, nylon, rayon and even flax to create stretch fabrics. This stretch characteristic makes it an excellent fiber for use in swimwear, hosiery and active sportswear. Spandex is used in stretch woven as well as knits and even stretch satin for eveningwear. It is most often seen advertised under the Dupont brand name of Lycra.

Polypropylene: An olefin fiber made from propylene is very strong and resilient. It provides greater coverage per pound than any other fiber, yet it is so light that it actually floats. While major uses of polypropylene are industrial and carpet applications, its good isolative properties make it desirable in high tech active wear where moisture transport is important (Frings, 1996).

C. Yarns: A group of fibers is twisted or spun into a continuous strand called a yarn, which is used to make fabric. A fabric's yarns affect functional and aesthetic performance such as hand, including drapability and texture, luster, durability, including strength and abrasion resistance and comfort. The two main types of yarns are (1) spun and (2) filament. Several individual or single yarns of either type may be twisted together to create larger, stronger, ply yarns (Brown and Rice, 2001).

Spun yarns: Spun yarns are composed of short fiber called staple fibers. As noted earlier, all natural fibers except silk are staple. Manufactured fiber occur as filaments but may be cut into staple, if desired. When staple fibers are twisted or spun into yarns, the many fiber end sticking out from spun yarns give them a dull appearance and a slightly fuzzy texture. Fabric made from spun yarns are comfortable.

Filament yarns: Filament yarns are composed of long fiber called filaments. All manufactured fibers start out as filaments. The only natural fiber occurring in filament form is silk. Because they contain long, continuous fibers and very low twist, smooth filament yarns are smooth filament-fiber yarn.

Fabrics made from smooth filament yarns have low loft, a slick hand, and lustrous appearance (unless they are texturized and delectated) and they resist pilling, soiling, and lining. Filament yarns are usually stronger than staple yarns of comparable size and fiber content. Filament yarns involve fewer production steps, so they cost less to make than staple yarns. However, they are also less absorbent than staple yarns and less comfortable to wear because they tend to stick to the skin when wet.

D. Fabric structure The structure of a fabric, or how it is fabricated, affects its aesthetic and functional performance. Fabric structure affects the hand of the fabric, including its drapability and texture. The structure of the fabric also affects luster, ability to stretch and breathe and strength and abrasion resistance. Fabrics can be formed in number of ways. The two most common methods of forming a fabric are weaving and knitting.

1. Weaving

Woven fabrics are made by interlacing warp yarn and filling yarn at right angles. Weaving begins with a process called warping : yarns are wound onto a beam and hung lengthwise on the loom. The three basic weaves are plain, twill and satin as shown in Figure 21(Frings,1996).

a) Plain weave: Plain weave is the simplest, most common weave. The warp and filling yarns alternately pass over and under each other, creating both horizontal and vertical surface interest. Fabrics woven by this method include a wide range of weights from broadcloth to duck.

b) Twill weave: Twill weave is created by passing the warp yarn over a number of filling yarns before going under one. The same pattern is repeated row after row, but each time the repetition begins on the next warp yarn, creating a diagonal weave that gives the cloth added strength and a diagonal surface interest. Denim is the most popular twill fabric.

c) Satin weave: Satin weave is achieved by one warp yarn crossing over the most possible filling yarns (or vice versa), creating floats on the face side of the fabric. The floats give the fabric luster and smoothness. But because they are caught into the fabric only at comparatively wide intervals, a satin weave does not have the same durability as the other weaves.

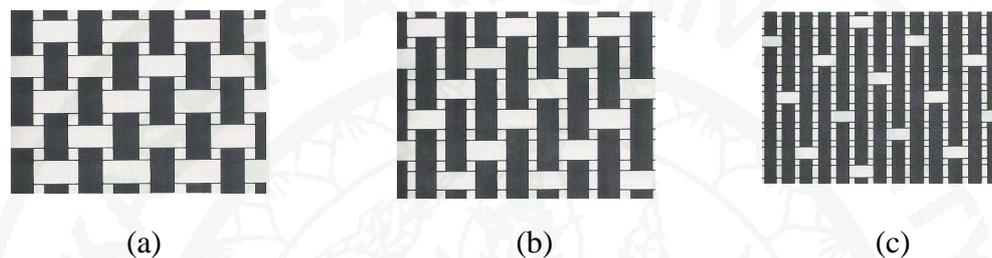


Figure 19 Basic weaves: (a) plain weave (b) twill weave and (c) satin weave.

source: Brown and Rice (2001)

2. Knits

Knitting is a major method of creating fabric used in apparel. The yarns in a knit fabric are a series of connected loops. The interloped structure of knit allows them to stretch significantly, making them more comfortable to wear than woven. The amount of stretch in the final product depends on the fiber and yarn construction, as well as the kind and density of the knit. Various types of stitches in combination with several ways of knitting produce a wide variety of knit fabrics from very bulky to fine – gauge. Designs can be transferred to a computer tape, which operates electronic knitting machines automatically. A modern knitting machine can knit one million loops a minute. Weft and warp knitting are the two basic methods of knitting fabric as shown in Figure 22.

a) Weft knitting: When the loops run horizontally across the width of the fabric, the process is called weft knitting. Weft knits can be made on either flatbed or circular machines, and circular knits may be either single or double

knit. In single knits, all the stitches in a given course, or row, are made with a single yarn. In double knits, the stitches in a given row may be made by interlocking two different yarn feeds. Weft knits are made in a wide variety of single and double knits and generally have more stretch than warp knits.

b) Warp knitting: In warp knitting, multiple yarns are used and the loops run vertically and zigzag across each other to form the fabric. Each stitch in a row is made by a different yarn that is fed from a sheet of yarns wound on a beam. Patterns and inlays can be introduced by various needle arrangements. Warp knits include tricot and raschel (Frings,1996).

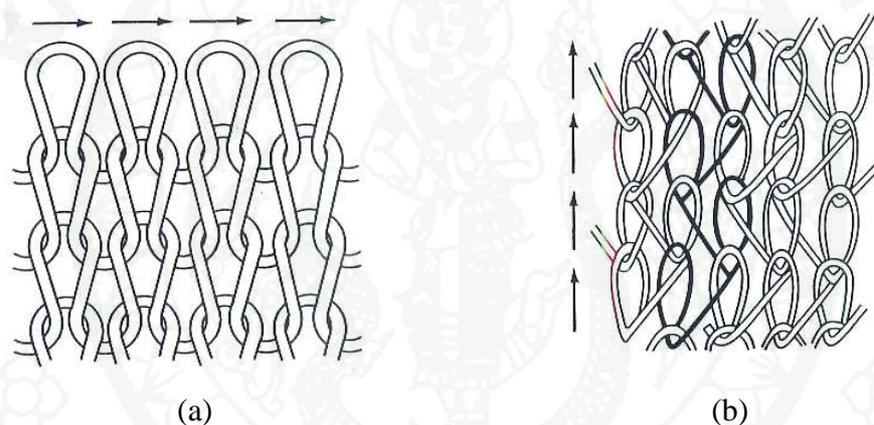


Figure 20 Knits: (a) weft knits (b) warp knits.

Source: Brown and Rice (2001)

3. Other fabric structure

A variety of other fabric structures including fiber web, bonded, film, lace, quilted and flocked fabrics, are significant for use in the apparel industry (Brown and Rice, 2001).

a) Fiber web or nonwoven fabrics: Fiber web or nonwoven fabrics are created by matting loose fibers together using a variety of techniques, including heat, adhesives and mechanical interlocking. Fiber webs are mainly used inside garments as interfacings to provide shape and stability because they are the least costly of all fabrics. Many of these nonwoven fabrics are backed with fusible adhesive for easy application. Nonwoven fabric production usually includes four stages: (1) fiber preparation, (2) web formation, (3) web bonding and (4) post-treatment. Nonwoven fabrics constitute one of the fastest growing segments of the textile industry. Felt is a familiar example of a nonwoven fabric (Frings,1996).

b) Bonded fabrics: Bonded fabrics are two distinct fabrics glued together as one. Laminated fabrics consist of a layer of fabric adhered to a layer of foam. Bonding and laminating may be used to add body to low-yarn-count fabrics. The main problems with low-quality bonded and laminated fabrics are uneven shrinking and separation of the two layers. Some film fabrics are bonded or laminated; few other apparel fabrics are bonded or laminated today.

c) Film fabrics: Film fabrics are continuous sheets of fabric made directly from a polymer solution, for example, plastic. Film fabrics are strong, durable and difficult to sew unless they are bonded or laminated. The most common plastic used in apparel applications is vinyl. Like many other synthetic materials, vinyl is a petroleum derivative. The most common vinyl material is polyvinyl chloride (PVC). Vinyl is widely used in raincoats and imitated leather in jackets and other apparel, as well as in belts, shoes and other accessories. It costs considerably less than leather and garments are cut from large sheets of vinyl more efficiently than from irregularly shaped leather hides.

d) Vinyl: Vinyl is generally considered to be of lower quality than leather because it tends to stiffen and crack with age. Also, vinyl melts if exposed to high temperatures. Vinyl is uncomfortable next to the skin because

it is not absorbent and does not breathe. The hand of vinyl depends on how much plasticizer the producer adds; more plasticizer results in a more flexible product. The producer adds air bubbles during the manufacturing process to create expanded vinyl; the air bubbles make these vinyl good insulators for cold-weather clothing. They closely imitate leather. Most vinyl may be wiped clean with a damp cloth or machine washed, but not machine dried.

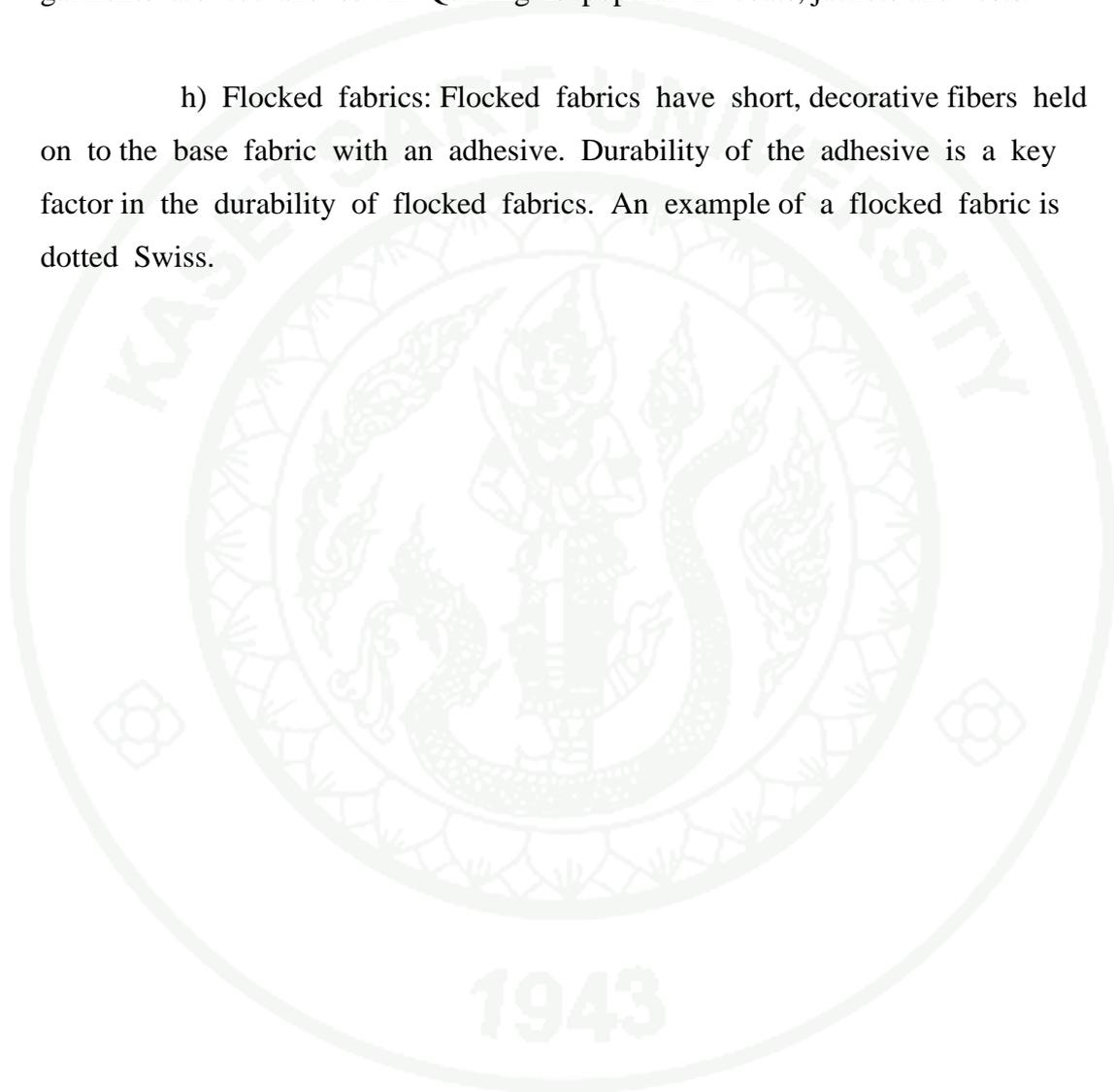
e) Polyurethane: Plastics are also used in apparel applications. For example, a synthetic, leather-like fabric is Ultra suede, a blend of polyester fibers and polyurethane plastic. Gore-Tex fabrics have a thin micro porous film of polytetrafluoroethylene (PTFE) that allows water vapor but not water droplets to pass through. This makes Gore-Tex fabrics ideal for all weather outer wear that is waterproof but allows the wearer's perspiration to evaporate for comfort. These fabrics are ideal for active sportswear, rainwear, skiwear, hunting clothing, etc.

f) Lace: Lace is a fabric structure resulting from twisting and knotting the yarns around one another. Although lace originated as a handcraft, almost all lace today is machine made. For example, machine-made laces imitate rocheted and tatted laces so well that they are difficult to tell from handmade. There are many, many different types of lace, fabricated in various ways. The cost of lace is related to its fiber content and the complexity of its production. High cost laces are made mainly on Leavers machines; low cost laces are made mainly on Rachel knitting machines. Schiff embroidery machines make eyelet (an embroidered fabric that is generally referred to as a lace). Laces generally have low tensile strength.

g) Quilted fabrics: Quilted fabrics consist of two fabric layers joined to a nonwoven interlining such as batting (filler), foam, feathers, or down. Most quilted fabrics are stitched together. The quilting stitches form a puffy, raised design, often in a geometric or other decorative pattern. Some quilting in low-price garments is joined by ultrasonic fusing instead of stitches, if the fabric is

made of thermoplastic fibers. Ultrasonic quilting is as durable as or more durable than stitched quilting, but its appearance is different, thus generating lower consumer acceptance than stitching. Stitched quilting costs more than fused quilting. Fabric is usually quilted by a quilting contractor before the garments are cut and sewn. Quilting is popular in coats, jackets and vests.

h) Flocked fabrics: Flocked fabrics have short, decorative fibers held on to the base fabric with an adhesive. Durability of the adhesive is a key factor in the durability of flocked fabrics. An example of a flocked fabric is dotted Swiss.



MATERIALS AND METHODS

Materials

1. Thai Body Structure Data

In order to determine Thai men and women sizes the Thai body structure data (Step 4, collected in the years 2000- 2001) were used. Thai women samples were 4,525 women from 31,660,225 of the Thai women population aged 17– 49 years. There were 1,066 women (23.6 %) from Bangkok and suburbs, 1,219 women (26.9 %) from the central part, 846 women (18.7%) from the northern part, 738 women (16.3 %) from the northeastern part, and 656 women (14.5%) from the southern part of the country.

Thai men samples were 4,301 men from 31,139,647 of the Thai men population aged 17 – 49 years. There were 1,266 men (28.2 %) from Bangkok and suburbs, 783 men (18.2 %) from the central part, 1,002 men (23.3 %) from the northeastern part, 801 men (18.6 %) from northern part, and 501 men (11.7 %) from the southern part of the country.

There were 142 points of measurement for women and 144 points for men. These were selected only the specific descriptions for Thai standard sizes model construction.

The descriptions selected for men sizes were neck girth, bust, waist, hip, chest width, front waist length, back width, center back length, shoulder length, arm length, center back, neck to wrist, upper arm, wrist, waist to feet, crotch depth, crotch length, crotch to soles of feet, waist length to knee, thigh, and ankle as shown in Figure 21 and Table 19.

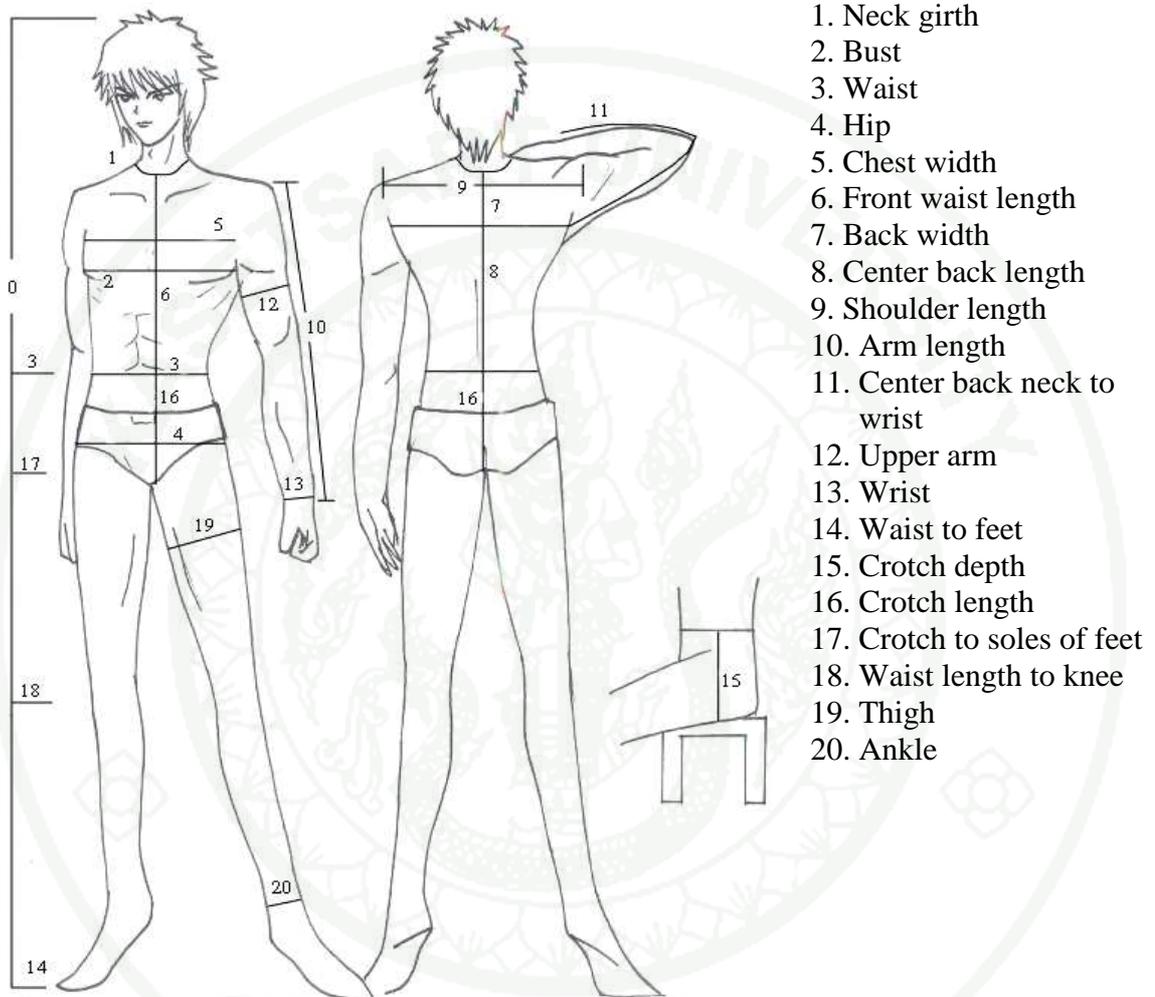


Figure 21 The body descriptions selected for Thai men sizes.

Table 19 Men's body measurement data.

Measurement	Age (Years)	Sizes (cm)				
		25 th	50 th	75 th	90 th	95 th
1 Neck girth	17-19	38	39	40	41.5	42
	20-29	38	39	40.5	42.5	43
	30-39	38.7	40	41.5	43	44
	40-49	39	40.5	42	41.5	44.4
2 Bust	17-19	79.5	82.5	86	90	93.6
	20-29	80.8	83.8	87.5	92	95
	30-39	84	87.4	91.2	95	98
	40-49	85	90	93	97	100
3 Waist	17-19	69	73	78	83	87.6
	20-29	70	74.5	79	85	89
	30-39	75	80	84.5	89.5	93
	40-49	78	83.5	88	92.5	96
4 Hip	17-19	83	86.5	90	95	98.1
	20-29	83	87	91	96	99
	30-39	86	90	94	98.5	101
	40-49	87.1	92	96	99.1	101
5 Chest width	17-19	33.5	35	37	38	39.6
	20-29	34	36	37.5	39	40
	30-39	35.5	37	39	41	42
	40-49	36	38	39.5	41	42
6 Front waist length	17-19	39.5	42	44	38	39.6
	20-29	40	42	44	39	40
	30-39	40.5	42.9	45	41	42
	40-49	41	43	46	41	42
7 Back width	17-19	35	36.5	38	40.4	42
	20-29	35	36.5	38.5	40	41.5
	30-39	35	37	39	41	42
	40-49	36	37.4	39.5	41	42.4
8 Center back length	17-19	45	47.5	49.7	51.5	53
	20-29	45.5	47.5	49.5	51	52
	30-39	45.5	47.5	49.5	51	52
	40-49	45.5	47	49.5	51	52

Table 19 (Continued)

Measurement	Age (Years)	Sizes (cm)				
		25 th	50 th	75 th	90 th	95 th
9 Shoulder length	17-19	37	39	41	42	43
	20-29	37	39	40.5	42	43
	30-39	37	39	40.5	42	43
	40-49	37	39	40	42	42.5
10 Am length	17-19	61.7	64	66.2	68.1	69.2
	20-29	61	63	65.1	67	68.2
	30-39	61	63	65	67.2	68.3
	40-49	60.7	62.6	64.8	66.6	67.7
11 Center back neck twist	17-19	75.5	78	80	82	84
	20-29	75	77.5	80	82	83
	30-39	75	77.2	80	82	83
	40-49	75	77	80	81	82
12 Upper arm	17-19	28	30	32	35	36
	20-29	28.5	30.5	32.6	35	36.9
	30-39	30	32	34	36.2	38
	40-49	30.6	33	35	37	39
13 Wrist	17-19	15.5	16	16.5	17.2	17.8
	20-29	15.5	16	16.5	17	17.5
	30-39	15.6	16.2	17	17.5	18
	40-49	16	16.5	17	17.8	18.1
14 Waist to feet	17-19	94.5	97.8	101	104.5	107
	20-29	94	97	100	103	105
	30-39	94	97	100	103	105
	40-49	94	97	100	103	105
15 Crotch depth	17-19	16.5	18.2	19.7	21.2	22
	20-29	16.7	18.2	19.6	21	22
	30-39	17	18.4	19.9	21.1	22
	40-49	17.3	18.7	20	21	22
16 Crotch length	17-19	62.2	65.5	69	72	74
	20-29	62	65.5	69.5	73	75
	30-39	63.5	67.3	71.5	75.5	78
	40-49	64.3	68	73	77	80.3

Table 19 (Continued)

Measurement	Age (Years)	Sizes (cm)				
		25 th	50 th	75 th	90 th	95 th
17 Crotch to soles of feet	17-19	75	78	80.6	83.4	85.2
	20-29	74.4	77	79.6	82.2	84
	30-39	73.4	76	79	81.5	83.5
	40-49	73	75.9	78.3	80.7	82
18 Waist length to knee	17-19	50	52	54	57	58
	20-29	50	51	53	55	57
	30-39	50	51.5	53	56	57
	40-49	50	51	53	56	56.5
19 Thigh	17-19	50	53	57	62	64
	20-29	50	54	58	62	65
	30-39	52.5	56	60	64	66
	40-49	53	57	60.5	64	67
20 Ankle	17-19	20.3	21.3	22.2	23.5	24.2
	20-29	20	21	22	23	23.7
	30-39	20.4	21	22	23	24
	40-49	20.5	21.4	22.4	23.4	24

Source: Thai Industrial Standard Institute (2001)

The descriptions selected for women sizes were neck girth, bust, waist, abdomen, hip, chest circumference, rib cage, bust radius, center neck to bust point, bust point to bust point, chest width, front waist length, back width, center back length, across shoulder, shoulder length, shoulder slope, arm length, upper arm, shoulder point to elbow, waist length to hip, waist length to knee, waist to floor, crotch depth, crotch length, crotch to soles of feet, thigh, and ankle as shown in Figure 22 and Table 20.

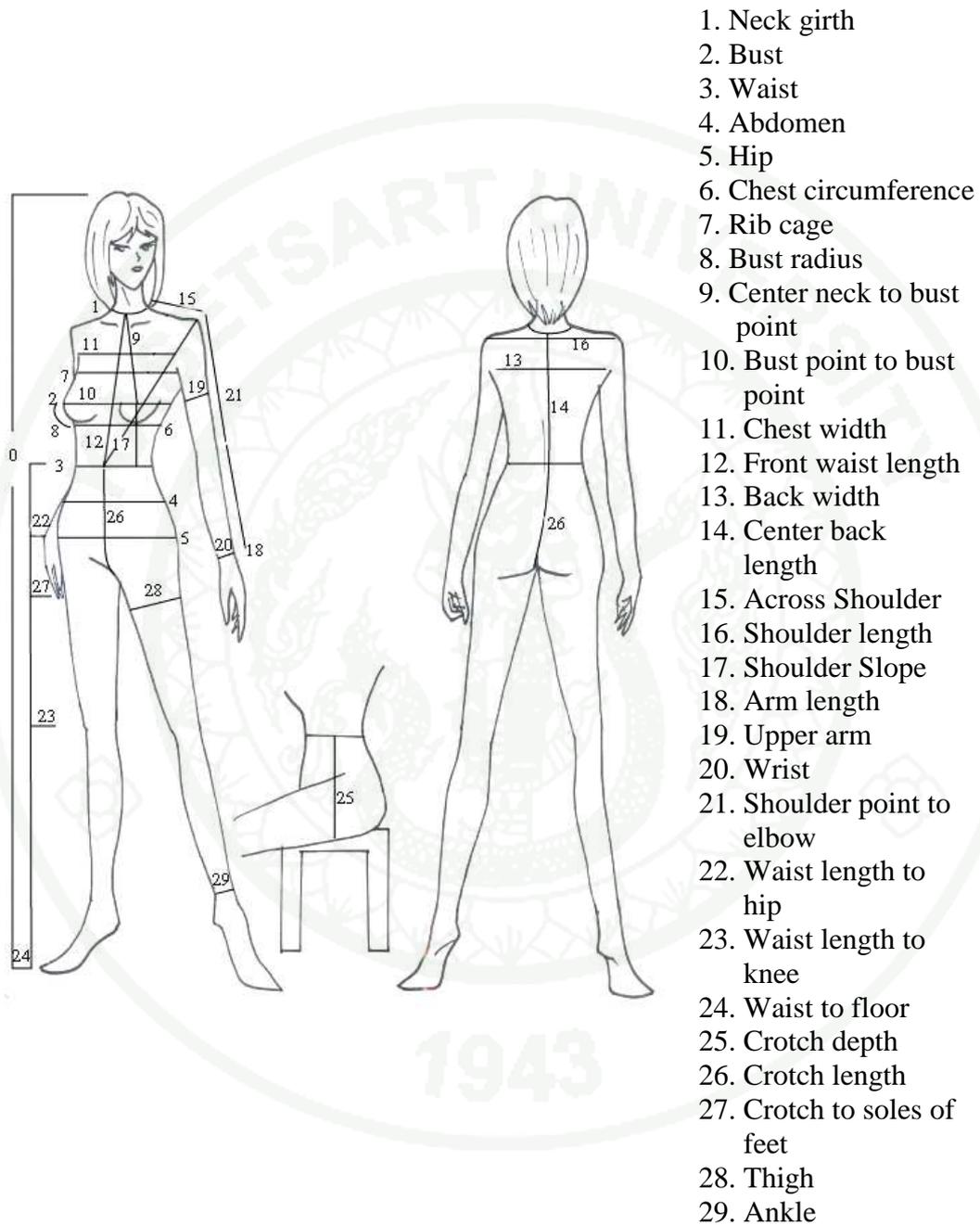


Figure 22 The body descriptions selected for Thai women sizes.

Table 20 Women's body measurement data.

Measurement	Age (Years)	Sizes (cm)				
		25 th	50 th	75 th	90 th	95 th
1 Neck girth	17-19	36	37.2	38.4	39.5	40
	20-29	36	37	38	39.5	40
	30-39	36.5	37.5	39	40	41
	40-49	37	38.5	40	41	42
2 Bust	17-19	77.5	81	85	89.5	93.5
	20-29	78.0	82	86	91.5	95.5
	30-39	80.6	85	90.5	96	101
	40-49	84.0	88.5	94.5	100.5	104.5
3 Waist	17-19	61	63.4	66.5	70.3	74
	20-29	61.5	64.4	68	72.5	76.3
	30-39	64	67.5	72.5	78.3	83
	40-49	67.5	71.5	76.5	83.2	87
4 Abdomen	17-19	75.9	79.5	82.5	86.5	90.4
	20-29	77	80.5	84.5	89	92.6
	30-39	81	85	90	95.3	99
	40-49	84.5	89	93.5	99	103.1
5 Hip	17-19	85	88	91.3	95	97.3
	20-29	85.3	88.5	92	96.5	99
	30-39	87.3	91	94.9	99.5	103
	40-49	89.4	93	97	101	104.1
6 Chest circumference	17-19	66.5	69	72	74	76
	20-29	67	69.5	72	76	78.5
	30-39	69	72	75	79.5	83
	40-49	71	74	78	82.3	85
7 Rib cage	17-19	74	76.5	79.5	82.7	85.5
	20-29	74.5	77.2	80.2	84	86.6
	30-39	76.5	79.5	83.5	87.5	90.9
	40-49	78.5	82	86	90.3	93.5
8 Bust radius	17-19	5.5	6.5	7	7.6	8.5
	20-29	5.5	6.5	7	8	8.5
	30-39	5.5	6	7	8	8.5
	40-49	5.5	6.5	7.5	8.5	9

Table 20 (Continued)

Measurement	Age (Years)	Sizes (cm)				
		25 th	50 th	75 th	90 th	95 th
9 Center neck bust point	17-19	18.5	19	20.5	22	23
	20-29	18.5	20	21.5	23	24
	30-39	19.5	21	23	24.5	26
	40-49	20.5	22	23.5	25.5	26.5
10 Bust point bust point	17-19	17.5	18.5	19.5	20.5	21
	20-29	17.5	18.5	19.5	20.8	21.5
	30-39	18	19	20	21	22
	40-49	18.5	19.5	21	22	23
11 Chest width	17-19	29.5	30.5	32	33.4	34
	20-29	30	31	32.5	34	34.8
	30-39	30.5	32	33.5	35	35.5
	40-49	31	32	34	35	36
12 Front waist length	17-19	29.5	30.5	32	33.5	34.5
	20-29	30	31.5	32.5	34	35
	30-39	30	31.5	33	34.5	35
	40-49	30.5	32	33.7	35	36.5
13 Back width	17-19	32	33.9	35.5	37	38
	20-29	32	33.5	35.2	37	38
	30-39	32.5	34.2	36	38	39
	40-49	33	34.5	36.5	38.5	40
14 Center back length	17-19	36	37	38.5	40	41
	20-29	35.7	37	38.5	40	41
	30-39	36	37.5	39	40.5	41.5
	40-49	36.5	38	39.5	41	42
15 Across Shoulder	17-19	10.5	11	12	12.5	13
	20-29	10.5	11.5	12.2	13	13.4
	30-39	10.6	11.5	12.2	13	13.5
	40-49	10.7	11.4	12.2	13	13.3
16 Shoulder length	17-19	35	36.5	38	39.5	40
	20-29	35.3	36.8	38.2	39.7	40.5
	30-39	35.5	37	38.5	39.8	41
	40-49	35	36.8	38.5	40	40.5

Table 20 (Continued)

Measurement	Age (Years)	Sizes (cm)				
		25 th	50 th	75 th	90 th	95 th
17 Shoulder Slope	17-19	76	76.5	77	78	79.5
	20-29	76	76.5	77	78	79.5
	30-39	76	76.5	77	78	79.5
	40-49	76	76.5	77	78	79.5
18 Am length	17-19	54.5	56	57.5	59	60
	20-29	54	55.8	57.3	59	60
	30-39	54	55.9	57.5	59	60
	40-49	54	55.9	57.5	59	60
19 Upper arm	17-19	24.8	26	27.7	29.2	30.2
	20-29	25	26.4	28	30.2	31.5
	30-39	26	27.8	30	32	33.9
	40-49	27.5	29	31	33	34
20 Wrist	17-19	14	14.5	15	15.5	16
	20-29	14	14.4	15	15.5	16
	30-39	14	14.5	15.2	15.8	16.2
	40-49	14.3	14.8	15.5	16	16.5
21 Shoulder point elbow	17-19	31.5	33	34	35	35.5
	20-29	31.5	32.5	33.5	34.5	35
	30-39	31.2	32.5	33.5	35	35
	40-49	31.4	32.5	33.5	35	35.4
22 Waist length to hip	17-19	20	21	22	23.5	24
	20-29	20	21	22	23.5	24
	30-39	19.5	21	22	23.5	24
	40-49	19.5	21	22	23.5	24
23 Waist length to knee	17-19	55	57	58.2	60	61
	20-29	55	56.5	58.3	60	61
	30-39	55	56	58	60	61
	40-49	54.5	56	58	60	61
24 Waist to floor	17-19	96.8	99.5	102	104.8	106.5
	20-29	96.5	99	102	104.5	106
	30-39	95.5	98.5	101	104	105.4
	40-49	94.6	98	101	103.5	104.9

Table 20 (Continued)

Measurement	Age (Years)	Sizes (cm)				
		25 th	50 th	75 th	90 th	95 th
25 Crotch depth	17-19	23.8	24.9	25.8	26.7	27.3
	20-29	23.4	24.6	25.7	26.6	27.2
	30-39	23.3	24.6	25.6	26.7	27.3
	40-49	23	24.3	25.4	26.7	27.4
26 Crotch length	17-19	31.1	32.75	34.5	36	37
	20-29	31	32.75	34.75	36.5	37.5
	30-39	31.75	33.65	35.75	37.75	39
	40-49	32.15	34	36.5	38.5	40.15
27 Crotch - soles of feet	17-19	68.8	71.4	73.9	76.4	78
	20-29	68.6	71.1	73.7	76.1	77.4
	30-39	67.7	70	72.4	75	76.3
	40-49	66.5	69.3	71.8	74.2	75.4
28 Thigh	17-19	48.6	51	53.8	57	59
	20-29	49	51.3	54.3	57.5	60
	30-39	50	53	56	59.5	62.5
	40-49	51.8	54.2	57.5	60.8	63.1
29 Ankle	17-19	19.4	20.2	21.5	22.5	23.1
	20-29	19.3	20.1	21.2	22.3	23
	30-39	19.4	20.3	21.3	22.5	23.1
	40-49	19.5	20.5	21.5	23	23.6

Source: Thai Industrial Standard Institute (2001)

2. Materials for Thai Model Construction

The raw materials for model construction compose of shell fabrics and interlining fabrics. The shell fabrics consisted of 1) light weight cotton 50 warp yarns by 50 filling yarns per 1 square inch made from 20 count yarn (A1), 2) medium weight cotton 60 warp yarns by 60 filling yarns per 1 square inch made from 20 count yarn (A2) and 3) heavy weight cotton 130 warp yarns by 70 filling yarns per 1 square inch and 20 count yarn (A3). The interlining fabrics consisted of 1) 8 mm thick sponge (B1), 2) 600 g/m 5 mm thick polyester nonwoven (B2), and 3) 200 g/m 5 mm thick polyester nonwoven (B3).

Methods

1.To Determine Standard Sizes of Thai Men and Women

There were four age groups of Thai men and women samples : 17-19, 20-29, 30-39 and 40-49 years. To find the mean sizes and grading value, the men and women body sizes of 25th, 50th, 75th, 90th, and 95th percentile were used in calculation. as follows,

- 1) Determined the mean body measurement of each percentile from the four age groups.
- 2) Determine the total mean body measurement of each description from the five percentiles.
- 3) Determine the range value of each description from measurement of the two percentiles (95th - 25th).
- 4) Determined the grading size of each body description by dividing the range value by 7.
- 5) The mean values were then adjusted and assigned as the medium size, and the grading sizes were adjusted and used to determine the other sizes (XXS, XS, S, L, XL, and XXL).

In seminar, the result of medium size was then used to make patterns by 3 D program and samples making by instructors and students of Rajamangala University of Technology Thanyaburi (RMUTT) and manufacturers from garment industries. All of participants discussed the results and adjusted the medium body sizes and the grading size.

2. To compare the Particular Standard Sizes among Thai, American, British and Japanese

American, British and Japanese standard sizes from a pattern making handbook were used in comparison with Thai size. The specific descriptions compared were bust girth, waist girth, hip girth, across back and back waist length. Each was in medium standard sizes. In comparison, the ratios of Thai size and other sizes were calculated.

3. To select the Suitable Materials for Thai Model Construction

3.1 Tensile strength and bursting strength of raw materials

Three shell fabrics and three interlining fabrics were tested for bursting strength and tensile strength. The first was A1. The others were A2, A3, B1, B2 and B3. After that, the shell fabrics and the interlining fabrics were matched in order to determine material sets; therefore, there were nine material sets used in the experiment. The first was A1B1. Others were A1B2, A1B3, A2B1, A2B2, A2B3, A3B1, A3B2 and A3B3.

3.2 Tensile strength and bursting strength of shell fabric and interlining fabric combinations

All material sets were tested for bursting strength and tensile strength according to the American society for testing and material standard test method (ASTM D 5035-95). After that, they were punctured by needle machines and they

were tested for bursting strength and tensile strength again. The three best material sets were selected to construction the Thai models.

4. To construct and Performance Evaluation of the Developed Models

4.1 Construction of the models

Thai standard size models were made as body sculptures by using papier-mache techniques. Three men models and three women models were constructed in Thai standard medium size by using the three best materials sets. Totally, There were six Thai standard size models used for performance evaluation.

4.2 Model performance evaluation

In performance evaluation, the test equipments were three men models, three women models and an evaluation form. The evaluation form was divided into two parts. The first part inquired about the characteristic backgrounds of instructors, students and manufacturers who participated in the performance evaluation. The second part inquired about the satisfaction level of the model's performance concerning, sizes of the model, thickness of the materials, convenience of punching pin on the model, tightness of fixed pin on the model, and total model quality. The satisfaction levels were rated: 1 (Fair), 2 (Good) and 3 (excellent). The performance of the models were evaluated by instructors and students of Rajamangala University of Technology Thanyaburi (RMUTT) and manufacturers from garment industries. Afterwards, all participants answered a reasonable performance test. Performance scores of all descriptions were determined. Total and average scores were then calculated and performance levels were determined as follow: 1.00-1.66 = Fair, 1.67-2.33 = Good and 2.34-3.00 = Excellent (Minieka,2000).

RESULTS AND DISCUSSION

1. Standard Sizes of Thai Men and Women

1.1 Thai men standard sizes

Table 21 Mean of each body measurement of Thai men.

No	Body measurement	Mean (cm)					Total
		P.25	P.50	P.75	P.90	P.95	
1	Neck girth	38.42	39.62	41.00	42.50	43.25	40.96
2	Bust	82.32	85.92	89.42	93.50	96.65	89.56
3	Waist	73.00	77.75	82.37	87.50	91.40	82.40
4	Hip	84.77	88.87	92.75	97.15	99.77	92.66
5	Chest width	34.75	36.50	38.25	39.75	40.00	37.85
6	Front waist length	40.25	42.25	47.75	46.75	48.00	45.00
7	Back width	35.25	36.85	38.75	40.60	41.97	38.68
8	Center back length	45.25	47.37	49.55	51.12	52.25	49.11
9	Shoulder length	37.00	39.00	40.50	42.00	42.87	40.27
10	Am length	61.10	63.15	65.27	67.22	68.42	65.03
11	Center back neck to wrist	75.12	77.42	79.75	81.75	83.00	79.41
12	Upper arm	29.27	31.37	33.40	35.80	37.25	33.42
13	Wrist	15.65	16.17	16.75	17.37	17.85	16.76
14	Waist to feet	94.12	97.20	100.25	103.37	105.50	100.09
15	Crotch depth	16.87	18.37	19.80	21.07	22.00	19.62
16	Crotch length	55.30	59.24	63.00	66.50	68.74	62.56
17	Crotch to soles of feet	73.95	76.72	79.37	81.91	83.67	79.12
18	Waist length to knee	50.00	51.37	53.25	56.00	57.12	53.55
19	Thigh	53.62	55.00	58.87	63.00	65.50	59.20
20	Ankle	20.30	21.17	22.15	23.22	23.97	22.16

Table 21 shows the mean body measurement of each percentile from the four age groups of Thai men (17-19, 20-29, 30-39 and 40-49 years) It was found that most of the mean values of P.75 were bigger than those of P.25, P.50 and the total mean but nearly smaller than those of P.90 and P.95. The total mean value of bust,

waist, wrist, waist length to knee, thigh and ankle were bigger than those of P.75 especially.

Table 22 Range and grading size of each body measurement for the Thai men standard sizes.

No	Body measurement	Range (cm)	Grading size (cm)
1	Neck girth	4.83	0.69
2	Bust	14.33	2.05
3	Waist	18.40	2.63
4	Hip	15.00	2.14
5	Chest width	5.25	0.75
6	Front waist length	7.75	1.11
7	Back width	6.72	0.96
8	Center back length	7.00	1.00
9	Shoulder length	5.87	0.84
10	Am length	7.32	1.05
11	Center back neck to wrist	7.88	1.13
12	Upper arm	7.98	1.14
13	Wrist	2.20	0.31
14	Waist to feet	11.38	1.63
15	Crotch depth	5.13	0.73
16	Crotch length	13.44	1.00
17	Crotch to soles of feet	9.72	1.39
18	Waist length to knee	7.12	1.02
19	Thigh	11.88	1.70
20	Ankle	3.67	0.52

The range and grading value of each body measurement are shown in Table 22. It was found that the range were 14.33 cm of bust, 18.40 cm of waist and 15.00 cm of hip. The grade size were 2.05 cm of bust, 2.63 cm of waist and 2.14 cm of hip. The grade size of waist was larger than bust and hip.

Table 23 Calculated and adjusted mean and grading size of each body measurement for the Thai men standard size.

No	Body Description	Mean (cm)		Grading size (cm)	
		Calculated	Adjustment	Calculated	Adjustment
1	Neck girth	40.96	40.00	0.69	1.00
2	Bust	89.56	90.00	2.05	2.00
3	Waist	82.40	82.00	2.63	2.50
4	Hip	92.66	93.00	2.14	2.00
5	Chest width	37.85	38.00	0.75	1.00
6	Front waist length	45.00	45.00	1.11	1.00
7	Back width	38.68	39.00	0.96	1.00
8	Center back length	49.11	49.00	1.00	1.00
9	Shoulder length	40.27	40.00	0.84	1.00
10	Am length	65.03	65.00	1.05	1.00
11	Center back neck wrist	79.41	79.00	1.13	1.00
12	Upper arm	33.42	33.00	1.14	1.00
13	Wrist	16.76	17.00	0.31	0.50
14	Waist to feet	100.09	100.00	1.63	1.50
15	Crotch depth	19.62	20.00	0.73	1.00
16	Crotch length	62.56	63.00	1.00	1.00
17	Crotch to soles of feet	79.12	79.00	1.39	1.00
18	Waist length to knee	53.55	56.00	1.02	1.00
19	Thigh	59.20	59.00	1.70	2.00
20	Ankle	22.16	22.00	0.52	0.50

In seminar, the result of medium size was then used to make patterns by 3 D program and samples making by instructors and students of Rajamangala University of Technology Thanyaburi (RMUTT) and manufacturers from garment industries. All of participants discussed the results and adjusted the medium body sizes and the grading. The Calculated and adjusted mean and grading size of each description of Thai men are shown in Table 23. Therefore, the mean was assigned as medium sizes (M). The others were extra extra small (XXS), extra small (XS), small (S), large (L), extra large (XL), and extra extra large (XXL). Thai men standard sizes are shown in Table 24.

Table 24 Thai men standard sizes.

NO.	Body measurement	Sizes (cm)						
		XXS	XS	S	M	L	XL	XXL
1	Neck girth	37.00	38.00	39.00	40.00	41.00	42.00	43.00
2	Bust	84.00	86.00	88.00	90.00	92.00	94.00	96.00
3	Waist	74.50	77.00	79.50	82.00	84.50	87.00	89.50
4	Hip	87.00	89.00	91.00	93.00	95.00	97.00	99.00
5	Chest width	35.00	36.00	37.00	38.00	39.00	40.00	41.00
6	Front waist length	42.00	43.00	44.00	45.00	46.00	47.00	48.00
7	Back width	36.00	37.00	38.00	39.00	40.00	41.00	42.00
8	Center back length	46.00	47.00	48.00	49.00	50.00	51.00	52.00
9	Shoulder length	37.00	38.00	39.00	40.00	41.00	42.00	43.00
10	Arm length	62.00	63.00	64.00	65.00	66.00	67.00	68.00
11	Center back neck to wrist	76.00	77.00	78.00	79.00	80.00	81.00	82.00
12	Upper arm	30.00	31.00	32.00	33.00	34.00	35.00	36.00
13	Wrist	15.50	16.00	16.50	17.00	17.50	18.00	18.50
14	Waist to feet	95.50	97.00	98.50	100.00	101.50	103.00	104.50
15	Crotch depth	17.00	18.00	19.00	20.00	21.00	22.00	23.00
16	Crotch length	60.00	61.00	62.00	63.00	64.00	65.00	66.00
17	Crotch to soles of feet	74.50	76.00	77.50	79.00	80.50	82.00	83.50
18	Waist length to knee	53.00	54.00	55.00	56.00	57.00	58.00	59.00
19	Thigh	53.00	55.00	57.00	59.00	61.00	63.00	65.00
20	Ankle	20.50	21.00	21.50	22.00	22.50	23.00	23.50

From Table 24, it was found that Thai men medium (average) sizes of 17 – 49 years were 40.00 cm neck, 90.00 cm bust, 82.00 cm waist, 93.00 cm hip, 38.00 cm chest width, 45.00 cm front waist length, 39.00 cm back width, 49.00 cm center back length, 40.00 cm shoulder length, 65.00 cm arm length, 79.00 cm center back neck to wrist, 33.00 cm upper arm, 17.00 cm. wrist, 100.00 cm waist to feet, 20.00 cm crotch depth, 63.00 cm crotch length, 79.00 cm crotch to soles of feet, 56.00 cm waist length to knee, 59.00 cm thigh, and 22.00 cm ankle.

1.2 Thai women standard sizes

Table 25 Mean of each body measurement of Thai women.

No	Body measurement	Mean (cm)					Total
		P.25	P.50	P.75	P.90	P.95	
1	Neck girth	36.75	37.55	38.55	40.00	40.75	38.72
2	Bust	80.02	84.12	89.00	84.37	98.37	87.18
3	Waist	63.50	66.70	70.87	76.07	80.00	71.43
4	Abdomen	79.60	83.50	87.62	92.45	96.27	87.89
5	Hip	86.75	90.12	93.57	98.00	100.85	93.86
6	Chest circumference	68.37	71.12	74.25	77.95	80.62	74.46
7	Rib cage	75.87	78.80	82.30	86.12	89.12	82.44
8	Bust radius	5.50	6.37	7.12	8.02	8.62	7.13
9	Center neck to bust point	19.25	20.50	22.12	23.75	24.87	22.10
10	Bust point to bust point	17.87	18.87	20.00	21.07	21.87	19.94
11	Chest width	30.25	31.37	33.00	34.35	35.07	32.81
12	Front waist length	30.50	31.75	32.80	34.25	35.37	32.93
13	Back width	32.37	34.02	35.80	37.62	38.75	35.71
14	Center back length	36.05	37.37	38.87	40.37	41.37	38.81
15	Across Shoulder	10.57	11.35	12.15	12.87	13.30	12.05
16	Shoulder length	35.20	36.77	38.30	39.75	40.50	38.10
17	Shoulder Slope	77.02	77.25	77.50	77.75	78.00	77.50
18	Am length	54.12	55.90	57.45	59.00	60.00	57.29
19	Upper arm	25.82	27.30	29.17	31.10	32.40	29.16
20	Wrist	14.07	14.55	15.17	15.70	16.17	15.13
21	Shoulder point to elbow	31.40	32.62	34.12	34.87	35.22	33.65
22	Waist length to hip	19.75	21.00	22.00	23.50	24.00	22.05
23	Waist length to knee	54.87	56.77	58.20	60.00	61.00	58.17
24	Waist to floor	95.85	98.75	101.50	104.20	105.70	101.20
25	Crotch depth	23.37	24.60	25.62	26.67	27.30	25.51
26	Crotch length	63.00	66.57	70.75	74.37	76.70	70.28
27	Crotch to soles of feet	67.90	70.70	72.95	75.42	76.72	72.74
28	Thigh	49.85	52.37	55.40	58.62	61.15	55.48
29	Ankle	19.40	20.27	21.37	22.57	23.20	21.36

Table 25 shows the mean body measurement of each percentile from the four age groups of Thai women (17-19, 20-29, 30-39 and 40-49 years) it was found that

most of the mean values of P.75 were bigger than those of P.25, P.50 and the total mean but nearly smaller than those of P.90 and P.95. The total mean value of neck, waist, abdomen, hip, chest circumference, rib cage, bust radius and thigh were bigger than those of P.75 especially.

Table 26 Range and grading size of each body measurement for the Thai women standard sizes.

No	Body measurement	Range (cm)	Grading size (cm)
1	Neck girth	4.00	0.57
2	Bust	18.35	2.62
3	Waist	16.50	2.36
4	Abdomen	16.67	2.38
5	Hip	14.10	2.01
6	Chest circumference	12.25	1.75
7	Rib cage	13.25	1.89
8	Bust radius	3.12	0.45
9	Center neck to bust point	5.62	0.80
10	Bust point to bust point	4.00	0.57
11	Chest width	4.82	0.69
12	Front waist length	4.87	0.70
13	Back width	6.38	0.91
14	Center back length	5.32	0.76
15	Across Shoulder	2.73	0.39
16	Shoulder length	5.30	0.76
17	Shoulder Slope	0.98	0.14
18	Am length	5.88	0.84
19	Upper arm	6.58	0.94
20	Wrist	2.10	0.30
21	Shoulder point to elbow	3.82	0.55
22	Waist length to hip	4.25	0.61
23	Waist length to knee	6.13	0.88
24	Waist to floor	9.85	1.41
25	Crotch depth	3.93	0.56
26	Crotch length	13.70	1.00
27	Crotch to soles of feet	8.82	1.26
28	Thigh	11.30	1.61
29	Ankle	3.80	0.54

The range and grading value of each body measurement are shown in Table 26. It was found that the range were 18.35 cm of bust, 16.50 cm of waist and 14.10 cm of hip. The grade size were 2.62 cm of bust, 2.36 cm of waist and 2.38 cm of hip. The grade size of bust was larger than waist and hip.

Table 27 Calculated and adjusted mean and grading size of each body measurement for the Thai women standard sizes.

No	Body Description	Mean (cm)		Grading size (cm)	
		Calculated	Adjusted	Calculated	Adjusted
1	Neck girth	38.72	38.00	0.57	1.00
2	Bust	87.18	87.00	2.62	2.50
3	Waist	71.43	71.00	2.36	2.00
4	Abdomen	87.89	88.00	2.38	2.00
5	Hip	93.86	94.00	2.01	2.00
6	Chest circumference	74.46	74.00	1.75	2.00
7	Rib cage	82.44	82.00	1.89	2.00
8	Bust radius	7.13	7.00	0.45	0.50
9	Center neck bust point	22.10	20.00	0.80	1.00
10	Bust point bust point	19.94	20.00	0.57	0.50
11	Chest width	32.81	33.00	0.69	1.00
12	Front waist length	32.93	33.00	0.70	1.00
13	Back width	35.71	36.00	0.91	1.00
14	Center back length	38.81	39.00	0.76	1.00
15	Across Shoulder	12.05	12.00	0.39	0.50
16	Shoulder length	38.10	38.00	0.76	1.00
17	Shoulder Slope	77.50	78.00	0.14	0.50
18	Am length	57.29	57.00	0.84	1.00
19	Upper arm	29.16	29.00	0.94	1.00
20	Wrist	15.13	15.00	0.30	0.50
21	Shoulder point elbow	33.65	34.00	0.55	0.50
22	Waist length to hip	22.05	22.00	0.61	0.50
23	Waist length to knee	58.17	58.00	0.88	1.00
24	Waist to floor	101.20	101.00	1.41	1.50
25	Crotch depth	25.51	26.00	0.56	0.50
26	Crotch length	70.28	70.00	1.00	1.00
27	Crotch soles of feet	72.74	73.00	1.26	1.00
28	Thigh	55.48	55.00	1.61	2.00
29	Ankle	21.36	21.00	0.54	0.50

The Calculated and adjusted mean and grading size of each description of Thai women are shown in Table 27. It was found that the grade size were adjusted to 2.50 cm (2.62 cm) for bust, to 2.00 cm (2.36 cm) for waist and to 2.00 cm (2.01 cm) for hip.

The mean was assigned as medium sizes (M). The others were extra extra small (XXS), extra small (XS), small (S), large (L), extra large (XL), and extra extra large (XXL). Thai women standard sizes are shown in Table 28.

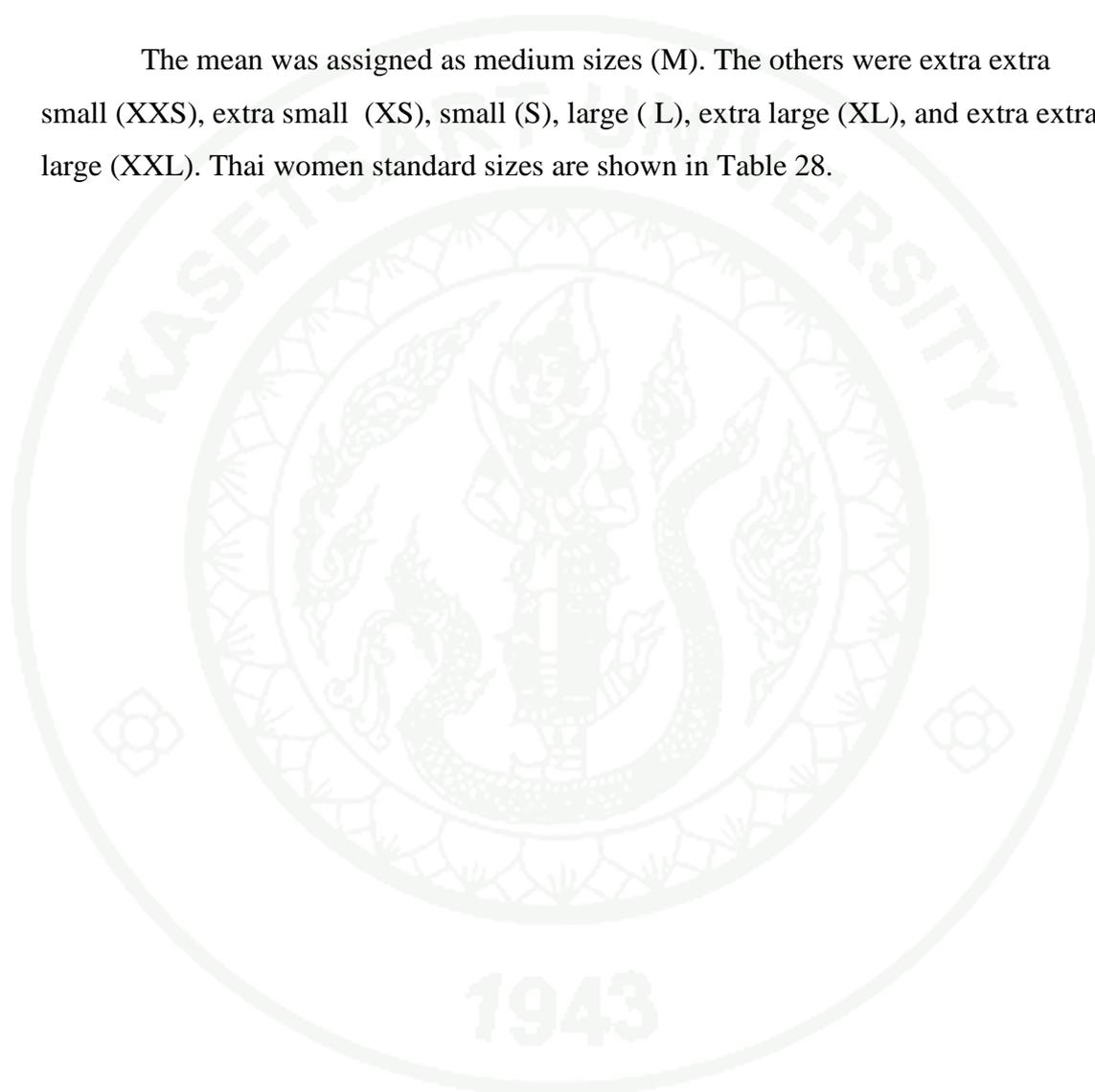


Table 28 Thai women standard size.

NO.	Body measurement	Sizes (cm)						
		XXS	XS	S	M	L	XL	XXL
1	Neck girth	36.50	37.00	37.50	38.00	38.50	39.00	39.50
2	Bust	79.50	82.00	84.50	87.00	89.50	92.00	94.50
3	Waist	65.00	67.00	69.00	71.00	73.00	75.00	77.00
4	Abdomen	82.00	84.00	86.00	88.00	90.00	92.00	94.00
5	Hip	89.00	90.00	92.00	94.00	96.00	98.00	100.00
6	Chest circumference	67.00	69.00	72.00	74.00	76.00	79.00	82.00
7	Rib cage	80.50	81.00	81.50	82.00	82.50	82.00	81.50
8	Bust radius	5.50	6.00	6.50	7.00	7.50	8.00	9.00
9	Center neck to bust point	17.00	18.00	19.00	20.00	21.00	22.00	23.00
10	Bust point to bust point	18.50	19.00	19.50	20.00	20.50	21.00	21.50
11	Chest width	30.00	31.00	32.00	33.00	34.00	35.00	36.00
12	Front waist length	30.00	31.00	32.00	33.00	34.00	35.00	36.00
13	Back width	33.00	34.00	35.00	36.00	37.00	38.00	39.00
14	Center back length	36.00	37.00	38.00	39.00	40.00	41.00	42.00
15	Across Shoulder	10.50	11.00	11.50	12.00	12.50	13.00	13.50
16	Shoulder length	35.00	36.00	37.00	38.00	39.00	40.00	41.00
17	Shoulder Slope	76.50	77.00	77.50	78.00	78.50	79.00	79.50
18	Arm length	54.00	55.00	56.00	57.00	58.00	59.00	60.00
19	Upper arm	26.00	27.00	28.00	29.00	30.00	31.00	32.00
20	Wrist	13.50	14.00	14.50	15.00	15.50	16.00	16.50
21	Shoulder point to elbow	32.50	33.00	33.50	34.00	34.50	36.00	36.50
22	Waist length to hip	20.00	21.00	21.50	22.00	22.50	23.00	23.50
23	Waist length to knee	55.00	56.00	57.00	58.00	59.00	60.00	61.00
24	Waist to floor	98.00	99.00	100.00	101.00	102.00	103.00	104.00
25	Crotch depth	24.50	25.00	25.50	26.00	26.50	27.00	27.50
26	Crotch length	67.00	68.00	69.00	70.00	71.00	72.00	73.00
27	Crotch to soles of feet	71.00	71.00	72.00	73.00	74.00	75.00	76.00
28	Thigh	49.00	51.00	53.00	55.00	57.00	59.00	61.00
29	Ankle	19.50	20.00	20.50	21.00	21.50	22.00	23.50

Thai women medium (average) sizes of 17 - 49 years were 38.00 cm neck, 87.00 cm bust, 71.00 cm waist, 88.00 cm abdomen, 94.00 cm hip, 74.00 cm chest circumference, 82.00 cm rib cage, 7.00 cm bust radius, 20.00 cm center neck to bust point, 20.00 cm bust point to bust point, 33.00 cm chest width, 33.00 cm front waist length, 36.00 cm back width, 39.00 cm center back length, 12.00 cm across shoulder, 38.00 cm shoulder length, 78.00 cm shoulder slope, 57.00 cm arm length, 29.00 cm upper arm, 15.00 cm wrist, 34.00 cm shoulder point to elbow, 22.00 cm waist length to hip, 58.00 cm waist length to knee, 101.00 cm waist to floor, 26.00 cm crotch depth, 70.00 cm crotch length, 73.00 cm crotch to soles of feet, 55.00 cm thigh, and 21.00 cm ankle.

The standard sizes of Thai men and women were based on Step 4, 2000 – 2001 data. The size groups had 7 intervals (Tables 24 and Table 28). The sizing system was a letter system. The number sizing was the most common method of sizing for the majority of mass produced clothing, especially in tailored and traditional clothing. Letter sizing were used in the size designations of S, M, and L. Letter sizing was an ordinary system in low price lines and helps in reducing inventory (Brown and Rice, 2001).

In the first seminar, Thai standard size patterns and grading were made by a 3D program. Participants selected the letter sizing system for Thai standard sizes because most of them were garment manufacturers. Furthermore, the letter sizing system will also offer different size ranges (Cooklin, 1990). The letter sizing system had different size charts of garments such as S=Small, M=Medium and L=Large. However, Thai standard size tables had a body description for patternmaking, which can be used to make tailor made (Make to Order) and ready to wear (Make to stock) clothing. Thai standard size tables were the perfect database for patternmaking, models and fitting which had problems with the professional skills of the employees. Thai standard size tables would be able to acquire men and women standard sizes for instructors, students and manufacturers.

2. Comparison the Particular Standard Sizes among Thai, American, British and Japanese

2.1 Comparison of men standard sizes among Thai, American, British and Japanese

Japanese, British and American standard sizes from a pattern making handbook were used in comparison with Thai size. The specific descriptions compared were bust, waist, hip, across back and back waist length. Each was in medium standard sizes. In comparison, the ratios of Thai size and other sizes were calculated. Results are shown in Table 29 and Table 30.

Table 29 Thai, Japanese, British and American men medium sizes.

Body measurement	Thai (M)	Japanese (48 R)	British 50	American 40
Bust	90	92	100	101
Waist	82	65.2	86	91
Hip	93	87	104	111
Across back	39	35	40	not given
Back waist length	49	38	45	not given

Table 30 The ratio of Thai men medium size to Japanese, British and American men medium sizes.

Body measurement	Thai (M):Japanese (48 R)	Thai (M):British (50)	Thai (M):American (40)
Bust	1:1.02	1:1.11	1:1.12
Waist	1:0.80	1:1.04	1:1.20
Hip	1:0.93	1:1.11	1:1.19
Across back	1:0.89	1:1.02	not given
Back waist length	1:0.97	1:0.91	not given

Table 29 and Table 30 show that bust size of Thai men was smaller than Japanese, British, and American sizes. Waist size of Thai men was bigger than Japanese but smaller than British and American sizes. Hip size of Thai men was bigger than Japanese sizes but smaller than British and American size. Across the back of Thai men was bigger than Japanese but smaller than British size. Back waist length size of Thai men was bigger than Japanese and British sizes.

2.2 Comparison of women standard sizes among Thai, American, British and Japanese

Table 31 Thai, Japanese, British and American women medium sizes.

Measurement	Thai (M)	Japanese (48 R)	British (50)	American (40)
Bust	87	82	91.5	88
Waist	71	66	66	68
Hip	94	90	95	93
Across back	36	34	34.4	37
Back waist length	39	38	40	44.5

Table 32 The ratio of Thai women medium sizes to Japanese, British and American women medium sizes.

Body measurement	Thai (M): Japanese (9)	Thai (M): British (10)	Thai (M): American (12)
Bust	1:0.94	1:1.05	1:1.01
Waist	1:0.92	1:0.92	1:0.95
Hip	1:0.95	1:1.01	1:0.98
Across back	1:0.94	1:0.95	1:1.02
Back waist length	1:0.97	1:1.02	1:1.14

Table 31 and Table 32 show that there were differences among Thai, American, British and Japanese women sizes. Thai women bust size was smaller than British and American sizes but bigger than the Japanese size. Thai women waist size was bigger than Japanese, British and American sizes. Thai women hip size was smaller than British sizes but bigger than Japanese and American sizes. Thai women across back size was bigger than Japanese and British sizes but smaller than American size. Thai women back waist length size was smaller than British size but bigger than Japanese and American sizes respectively.

3. Selection the Suitable Materials for Thai Model Construction

The raw materials for model construction compose of shell fabrics and interlining fabrics. The shell fabrics consisted of 1) light weight cotton 50 warp yarns by 50 filling yarns per 1 square inch made from 20 count yarn (A1), 2) medium weight cotton 60 warp yarns by 60 filling yarns per 1 square inch made from 20 count yarn (A2) and 3) heavy weight cotton 130 warp yarns by 70 filling yarns per 1 square inch made from 20 count yarn (A3). The interlining fabrics consisted of 1) 8 mm thick sponge (B1), 2) 600 g/m 5 mm thick polyester nonwoven (B2), and 3) 200 g/m 5 mm thick polyester nonwoven (B3).

3.1 Tensile strength and bursting strength of raw materials

The raw materials, three shell fabrics (A1, A2 and A3) and three interlining fabrics. B1, B2 and B3 were tested for tensile strength (ASTM D 3786-87) and bursting strength (ASTM D 5035-95) at the laboratory of New World International LTD.PART. The results are shown in Table 33 and 34.

Table 33 Mean tensile strength of the shell and interlining fabrics.

Fabrics	Tensile strength (Kg. force)	
	Machine direction	Cross direction
A1	39.43	33.45
A2	34.98	33.39
A3	72.46	61.96
B1	3.24	3.20
B2	29.06	28.05
B3	3.57	3.45

Table 33 shows that the A3 shell fabric and the B2 interlining fabric had the highest tensile strength.

Table 34 Mean bursting strength of the shell and interlining fabrics.

Fabrics	Bursting strength (Kg.force)
A1	6.33
A2	7.46
A3	15.5
B1	1.06
B2	>25.00
B3	5.70

Table 34 shows that the A3 shell fabric and the B2 interlining fabric had the highest bursting strength. The force used for testing was 25 kilogram but the B2 was not bursted. Therefore, the B2 fabric needed more than 25 kilogram to burst.

The results shows that the A3 shell fabric was better than A1 and A2 and the B2 interlining fabric was better than B1 and B3.

3.2 Tensile strength and bursting strength of shell fabric and interlining fabric combinations

There were nine sets of combinations between the shell fabrics and interlining fabrics. The results of tensile strength tests indicated that the A2B2, A3B2 and A3B3 were stronger than the other combinations both before and after needle punching. The results of bursting strength tests indicated that the A1B1, A1B2, A2B1, A2B2, A3B2 and A3B3 were stronger than the other combinations both before and after needle punching. Consequently, A2B2, A3B2, A3B3 were selected for Thai models construction.

The first was A1B1. The others were A1B2, A1B3, A2B1, A2B2, A2B3, A3B1, A3B2, and A3B3.

Table 35 Mean tensile strength of the fabric combinations before needle punching.

Fabric combination	Tensile strength (Kg.force)	
	Machine direction	Cross direction
A1B1	43.98	35.33
A1B2	61.3	50.79
A1B3	33.19	27.7
A2B1	34.23	31.6
A2B2	64.97	69.87
A2B3	33.49	33.74
A3B1	84.54	55.34
A3B2	91.04	69.15
A3B3	68.91	59.03

From Table 34, it was found that before needle punching the A3B2 had the highest tensile strength in machine direction followed by the A3B1 and the A3B3. The A2B2 had the highest tensile strength in cross direction followed by the A3B2 and the A3B3.

Table 36 Mean tensile strength of the fabric combinations after needle punching.

Fabric combination	Tensile strength (Kg.force)	
	Machine direction	Cross direction
A1B1	34.45	38.35
A1B2	60.87	63.16
A1B3	37.88	28.92
A2B1	34.68	32.02
A2B2	68.27	50.18
A2B3	35.78	31.00
A3B1	17.07	12.99
A3B2	95.98	66.09
A3B3	83.46	71.62

From Table 36, it was found that after needle punching the A3B2 had the highest tensile strength in machine direction followed by the A3B3 and the A2B2. The A3B3 had the highest tensile strength in cross direction followed by the A3B2 and the A1B2.

Accordingly, for tensile strength, it was found that A3B2 was the strongest both of before and after needle punching.

Table 37 Mean bursting strength of the fabric combinations before needle punching.

Fabric combination	Bursting strength (Kg.force)
A1B1	>25.00
A1B2	>25.00
A1B3	11.43
A2B1	>25.00
A2B2	>25.00
A2B3	15.56
A3B1	16.01
A3B2	>25.00
A3B3	>25.00

Table 37 shown the results of bursting strength before needle punching: it was found the A1B1, A1B2, A2B2, A3B2 and A3B3 had higher than 25 kilogram of bursting strength, therefore were considered as the most strong fabric sets before needle punching.

Table 38 Mean bursting strength of the fabric combinations after needle punching.

Fabric combination	Bursting strength (Kg.force)
A1B1	>25.00
A1B2	>25.00
A1B3	11.73
A2B1	>25.00
A2B2	>25.00
A2B3	15.5
A3B1	15.86
A3B2	>25.00
A3B3	>25.00

Table 38 shown the results of bursting strength after needle punching: it was found the A1B1, A1B2, A2B1, A2B2, A3B2 and A3B3 had higher than 25 kilogram of bursting strength, there were considered as the most strong fabric sets after needle punching.

Table 39 The ranking of tensile strength and bursting strength of the fabric combinations.

Fabrics combination	Ranking						The sum total score of no.1
	Tensile strength				Bursting strength		
	Before punching	After punching	Before punching	After punching	Before punching	After punching	
	MD	CD	MD	CD			
A1B1	6	7	8	5	1	1	2
A1B2	5	5	4	3	1	1	2
A1B3	9	9	5	8	4	4	0
A2B1	7	8	7	6	1	1	2
A2B2	4	1	3	4	1	1	3
A2B3	8	6	6	7	3	3	0
A3B1	2	4	9	9	2	2	0
A3B2	1	2	1	2	1	1	4
A3B3	3	3	2	1	1	1	3

Table 39, shows the sum of ranking no.1 concerning tensile strength and bursting strength, it was found that the A3B2, obtained 4 No. 1 rankings; the A2B2 and the A3B3 obtained 3 No.1 rankings. Therefore, it was concluded that those three fabric combination were the strongest materials both before and after needle punching. Consequently, the A2B2, A3B2, and A3B3 were selected for Thai models construction.

4. Construction and Performance Evaluation of the Developed Models

4.1 Construction of the models

The sculptured models were made by papier – mache technique (Figure 23-24). The Thai men medium sizes models were 40.00 cm neck, 90.00 cm bust, 82.00 cm waist, 93.00 cm hip, 38.00 cm chest width, 45.00 cm front waist length, 39.00 cm back width, and 49.00 cm center back length. The Thai women medium

sizes were 37.00 cm neck, 87.00 cm bust, 71.00 cm waist, 88.00 cm abdomen, 94.00 cm hip, 74.00 cm chest circumference, 82.00 cm rib cage, 7.00 cm bust radius, 20.00 cm center neck to bust point, 33.00 cm front waist length, 36.00 cm back width, and 39.00 cm center back length.



Figure 23 The papier – mache men model.



Figure 24 The papier – mache women model.



Figure 25 Inside of the constructed papier – mache model.



Figure 26 Outside of the constructed papier – mache model.

Figure 25 and Figure 26 show the papier-mache technique used to make the men models and the women models. The models were then covered with A2B2, A3B2, and A3B3 fabrics. The three men models and three women models were made. After the models were finished (Figure 27 and 28) performance tests were then conducted.



A2B2 Model

A3B2 Model

A3B3 Model

Figure 27 The women models used for performance test.



A2B2 Model

A3B2 Model

A3B3 Model

Figure 28 The men models used for performance test.

4.2 Model performance evaluation

The test equipments were three men models, three women models and an evaluation form. The evaluation form was divided into two parts. The first part inquired about the characteristic backgrounds of instructors, students and manufacturers who evaluation the models. The second part inquired about the satisfaction level of the model's performance such as, sizes of the model, thickness of the material, convenience of punching pin on the model, tightness of fixed pin on the model, and the total model quality. The satisfaction levels were rated as 1 (Fair), 2 (Good) and 3 (excellent). The performance of the models were evaluated by instructors, students of Rajamangala University of Technology Thanyaburi (RMUTT) and manufacturers from garment industries. Afterwards, all participants answered a reasonable performance test. Performance scores of all descriptions were determined. Total scores, and average scores were then calculated and performance levels were determined as follow: 1.00-1.66 = Fair, 1.67-2.33 = Good and 2.34-3.00 = Excellent. The results were as follows:

4.2.1 Backgrounds of the evaluators

Table 40 Gender of the evaluators.

Gender	Number	Percentage
Men	4	13.33
Women	26	86.67
Total	30	100.00

From Table 40, it was found that there were a total of 30 evaluators. Most of those evaluators (86.67 %) were women, and a few of them (13.33 %) were men.

Table 41 Education of the evaluators.

Education level	Number	Percentage
Lower Undergraduate	4	13.33
Undergraduate	20	66.67
Postgraduate	6	20.00
Total	30	100.00

From Table 41, it was found that most of the evaluators (66.67 %) had an undergraduate level of education. A few of them (20%) had a postgraduate level of education, and only 4 people (13.33 %) had lower than an undergraduate level of education.

Table 42 Income of the evaluators.

Income/Bath	Number	Percentage
5,000 and Lower	0	0.00
5,001-10,000	5	16.67
10,001-15,000	10	33.33
Over 15,000	15	50.00
Total	30	100.00

From Table 42, it was found that the income of the evaluators were as follows: There were 15 people (50%) with an income of over 15,000 bath, 10 people (33.33 %) with an income between 10,001-15,000 bath, and 5 people (16.67 %) with an income between 5,001-10,000 baht. Nobody had an income lower than 5,000 bath.

Table 43 Experience of the evaluators.

Experience	Number	Percentage
3-5 years	15	50.00
6-10 years	4	13.33
11-15 years	2	6.66
Over 15 years	9	30.00
Total	30	100.00

As can be seen in Table 43, the experience of the evaluators was as follows: 15 people (50 %) had experience of 3-5 years, 9 people (30 %) had experience of over 15 years, 4 people (13.33 %) had experience of 6-10 years, and 2 people (6.66 %) had experience of 11-15 years.

4.2.2 Model performance

The satisfaction levels were rated as 1(fair), 2(good) and 3 (excellent). The performance scores were calculated and the results are shown in Table 44-49.

Table 44 Performance scores of the number one (A2B2) men model.

Description	Scores				Average	Performance level
	Fair(1)	Good(2)	Excellent(3)	Total		
Sizes of the model	10	38	3	51	1.7	Good
Thickness of the materials	12	32	6	50	1.67	Good
Convenience of punching pin on the model	14	30	3	47	1.57	Fair
Tightness of fixed pin on the models	13	30	6	49	1.63	Fair
Total model Quality	11	38	0	49	1.63	Fair
Total	60	168	18	246	1.64	Fair

From Table 44, it was found that the number one (A2B2) men model had the highest score concerning sizes of the model. The average scores of all descriptions were at a fair level except those of concerning size of the model and thickness of the materials. The total score was also at a fair level.

Table 45 Performance scores of the number two (A3B2) men model.

Description	Scores			Total	Average	Performance level
	Fair(1)	Good(2)	Excellent(3)			
Sizes of the model	7	42	6	55	1.83	Good
Thickness of the materials	5	42	12	59	1.97	Good
Convenience of punching pin on the model	8	24	30	62	2.07	Good
Tightness of fixed pin on the models	8	26	27	61	2.03	Good
Total model Quality	9	36	9	54	1.80	Good
Total	37	170	84	291	1.94	Good

From Table 45, it was found that the number two (A3B2) men model had the highest score concerning convenience of punching pin on the model. The average scores of all descriptions were at a good level. The total score was also at a good level.

Table 46 Performance scores of the number three (A3B3) men model.

Description	Scores			Total	Average	Performance level
	Fair(1)	Good(2)	Excellent(3)			
Sizes of the model	6	40	12	58	1.93	Good
Thickness of the materials	9	32	15	56	1.87	Good
Convenience of punching pin on the model	5	32	27	64	2.13	Good
Tightness of fixed pin on the models	5	12	48	65	2.17	Good
Total model Quality	5	18	21	44	1.47	Good
Total	30	134	123	287	1.92	Good

From Table 46, it was found that the number three (A3B3) men model had the highest score concerning tightness of fixed pin on the models. The average scores of all descriptions were at a good level except that of concerning total model quality. The total score was also at a good level.

Table 47 Performance scores of the number one (A2B2) women model.

Description	Scores			Total	Average	Performance level
	Fair(1)	Good(2)	Excellent(3)			
Sizes of the model	7	38	12	57	1.90	Good
Thickness of the materials	15	28	3	46	1.53	Fair
Convenience of punching pin on the model	12	34	3	49	1.63	Fair
Tightness of fixed pin on the models	12	26	15	53	1.77	Good
Total model Quality	10	36	6	52	1.73	Good
Total	56	162	39	257	1.72	Good

From Table 47, it was found that the number one (A2B2) women model had the highest score concerning sizes of the model. The average scores of all description were at a good level except those of concerning thickness of the materials and convenience of punching pin on the model. The total score was also at a good level.

Table 48 Performance scores of the number two (A3B2) women model.

Description	Scores					Performance level
	Fair(1)	Good(2)	Excellent(3)	Total	Average	
Sizes of the model	4	44	12	60	2.00	Good
Thickness of the materials	6	32	24	62	2.07	Good
Convenience of punching pin on the model	3	36	27	66	2.20	Good
Tightness of fixed pin on the models	6	30	27	63	2.10	Good
Total model Quality	9	32	15	56	1.87	Good
Total	28	174	105	307	2.05	Good

From Table 48, it was found that the number two (A3B2) women model had the highest score concerning convenience of punching pin on the model . The average scores of all descriptions were at a good level The total score was also at a good level.

Table 49 Performance scores of the number three (A3B3) women model.

Description	Scores					Performance level
	Fair(1)	Good(2)	Excellent(3)	Total	Average	
Sizes of the model	4	42	15	61	2.03	Good
Thickness of the materials	11	30	12	53	1.77	Good
Convenience of punching pin on the model	8	24	30	62	2.07	Good
Tightness of fixed pin on the models	6	22	39	67	2.23	Good
Total model Quality	6	36	18	60	2.00	Good
Total	35	154	114	303	2.02	Good

From Table 49, it was found that the number three (A3B3) women model had the highest score concerning tightness of fixed pin on the models. The average scores of all descriptions were at a good level. The total score was also at a good level.

Table 50 A comparison of total performance scores of the constructed models.

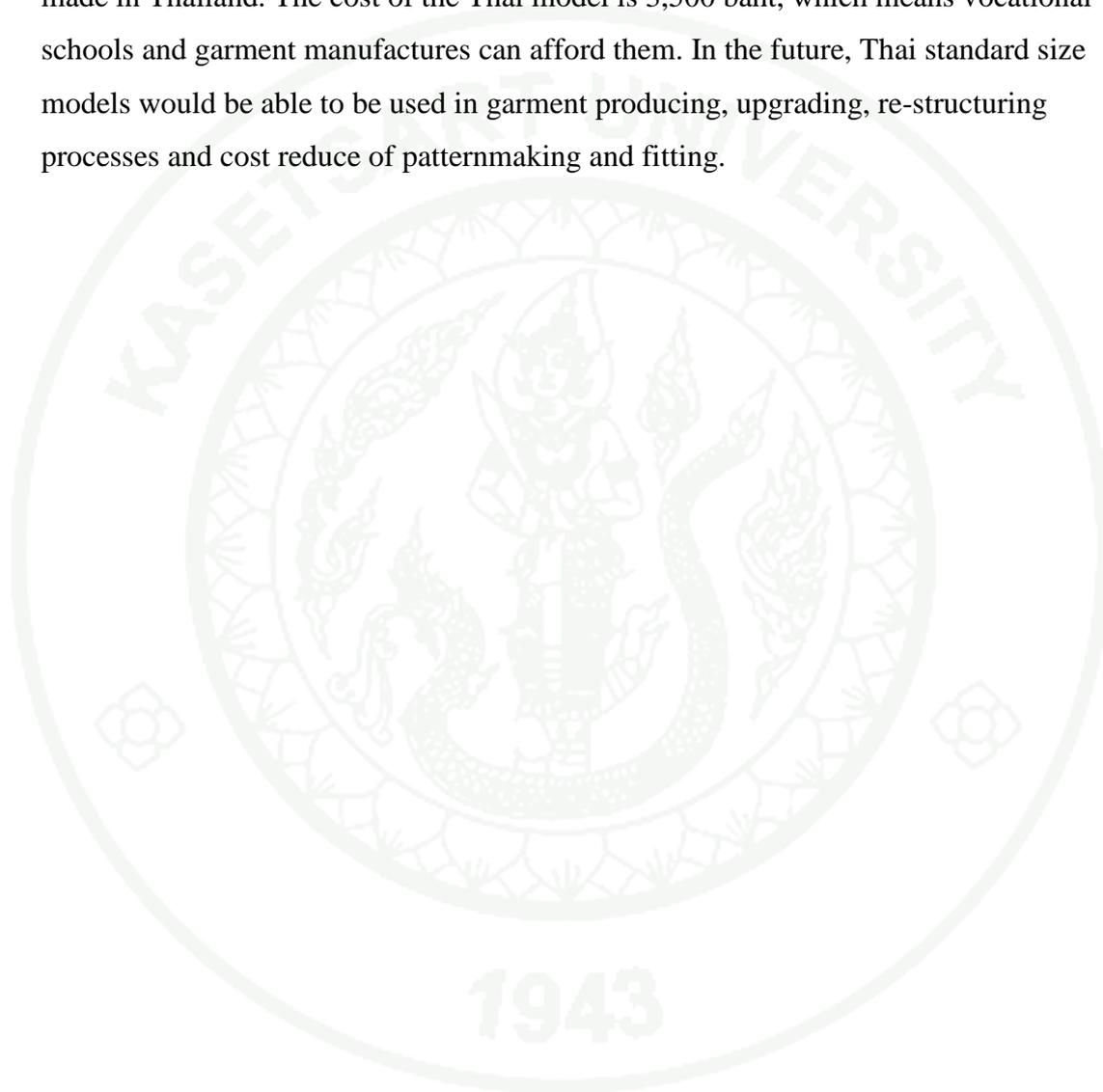
Gender	Number	Scores		Performance level
		Total	Average	
Men	1	246	1.64	Fair
	2	291	1.94	Good
	3	287	1.92	Good
Women	1	257	1.72	Good
	2	307	2.05	Good
	3	303	2.02	Good

From Table 50, it was found that the number two (A3B2) women model had the highest score which was higher than the number two (A3B2) men model. The number two (A3B2) men model had the highest score among men models and the number two (A3B2) women model had the highest score among women models as well.

The model itself was the dressmaking tool in the shape of a human body (Calasibetta, 1998). The model making techniques had several types such as, sculpture or modeling, carving, casting and papier- Mache (Leaper, 2003). Thai standard size models were made by using the papier-mache technique, which had less weight. The model construction was made with paper and the combinational cover was made from metal. The model or the mannequins were important equipment for patternmaking and fitting. The pin on models must be tightness of fixed pin on the models and convenience of punching pin.

Therefore, from the information above, the model 2 (A3B2) had been selected to be the best model performance because A3 (shell fabric) was a heavy cotton and B2 (interlining) was 600g/m² 5mm thick of nonwoven polyester, which was similar to the British models that were made from Linen shell fabric and nonwoven interlining (Kennett and Lindsell,1998). It was an appropriate set of fabrics which resulted in its strength and its tightness of fixed pin performance for the models. The

results of the model performance test had been used to make women and men prototype models which had been used to be the prototype models in the model industry. Thus, Thai standard size models were made as a half-length version and their stands were made from good quality metal, which was low price because it was made in Thailand. The cost of the Thai model is 3,500 baht, which means vocational schools and garment manufactures can afford them. In the future, Thai standard size models would be able to be used in garment producing, upgrading, re-structuring processes and cost reduce of patternmaking and fitting.



CONCLUSION AND RECOMMENDATION

Conclusion

The objective of this research were: 1) To determine standard sizes of Thai men and women, 2) To compare the particular standard sizes among Thai, American, British and Japanese, 3) To select the suitable materials for Thai models construction, and 4) To construct and performance evaluation of the developed models.

In order to determine Thai men and women sizes the Thai body structure data (Step 4, collected in the years 2000- 2001) were used. Thai women samples were 4,525 women from 31,660,225 of the Thai women population aged 17– 49 years.

Thai men samples were 4,301 men from 31,139,647 of the Thai men population aged 17 – 49 years. There were 142 points of measurement for women and 144 points for men. The descriptions selected for men sizes were neck girth, bust, waist, hip, chest width, front waist length, back width, center back length, shoulder length, arm length, center back, neck to wrist, upper arm, wrist, waist to feet, crotch depth, crotch length, crotch to soles of feet, waist length to knee, thigh, and ankle. The descriptions selected for women sizes were neck girth, bust, waist, abdomen, hip, chest circumference, rib cage, bust radius, center neck to bust point, bust point to bust point, chest width, front waist length, back width, center back length, across shoulder, shoulder length, shoulder slope, arm length, upper arm, shoulder point to elbow, waist length to hip, waist length to knee, waist to floor, crotch depth, crotch length, crotch to soles of feet, thigh, and ankle. Only the body sizes of 25th, 50th, 75th, 90th, and 95th percentile were used.

The raw materials for model construction compose of shell fabrics and interlining fabrics. The shell fabrics consisted of 1) light weight cotton 50 warp yarns by 50 filling yarns per 1 square inch made from 20 count yarn (A1), 2) medium weight cotton 60 warp yarns by 60 filling yarns per 1 square inch made from 20 count yarn (A2) and 3) heavy weight cotton 130 warp yarns by 70 filling yarns per 1

square inch and 20 count yarn (A3). The interlining fabrics consisted of 1) 8 mm thick sponge (B1), 2) 600 g/m 5 mm thick polyester nonwoven (B2), and 3) 200 g/m 5 mm thick polyester nonwoven (B3).

To determine standard sizes of Thai men and women the following steps were conducted. 1) Determined the mean body measurement of each percentile from the four age groups. 2) Determine the total mean body measurement of each description from the five percentiles. 3) Determine the range value of each description from measurement of the two percentiles (95th - 25th). 4) Determined the grading size of each body description by dividing the range value by 7. 5) The mean values were then adjusted and assigned as the medium size, and the grading sizes were adjusted and used to determine the other sizes (XXS, XS, S, L, XL, and XXL).

In comparison the particular standard sizes among Thai, American, British and Japanese, American, British and Japanese standard sizes from a pattern making handbook were used. The specific descriptions compared were bust girth, waist girth, hip girth, across back and back waist length. Each was in medium standard sizes. In comparison, the ratios of Thai size and other sizes were calculated.

To select the suitable materials for Thai model construction, three shell fabrics and three interlining fabrics were tested for bursting strength and tensile strength. After that, the shell fabrics and the interlining fabrics were matched in order to determine material sets; therefore, there were nine material sets used in the experiment. The first was A1B1. Others were A1B2, A1B3, A2B1, A2B2, A2B3, A3B1, A3B2 and A3B3. Tensile strength and bursting strength of shell fabric and interlining were then tested both before and after needle punching. To construct and evaluate performance of the developed models, three men models and three women models were constructed in Thai standard medium size by using the three best materials sets. Totally, there were six Thai standard size models used for performance evaluation.

In performance evaluation, the test equipments were three men models, three women models and an evaluation form. The satisfaction levels were rated: 1 (Fair), 2 (Good) and 3 (excellent). The performance of the models were evaluated by instructors and students of Rajamangala University of Technology Thanyaburi (RMUTT) and manufacturers from garment industries. Total and average scores were then calculated and performance levels were determined as follow: 1.00-1.66 = Fair, 1.67-2.33 = Good and 2.34-3.00 = Excellent.

The results are as follows:

1. Thai men medium (average) sizes of 17 – 49 years were 40.00 cm neck, 90.00 cm bust, 82.00 cm waist, 93.00 cm hip, 38.00 cm chest width, 45.00 cm front waist length, 39.00 cm back width, 49.00 cm center back length, 40.00 cm shoulder length, 65.00 cm arm length, 79.00 cm center back neck to wrist, 33.00 cm upper arm, 17.00 cm. wrist, 100.00 cm waist to feet, 20.00 cm crotch depth, 63.00 cm crotch length, 79.00 cm crotch to soles of feet, 56.00 cm waist length to knee, 59.00 cm thigh, and 22.00 cm ankle.

2. Thai women medium (average) sizes of 17 - 49 years were 38.00 cm neck, 87.00 cm bust, 71.00 cm waist, 88.00 cm abdomen, 94.00 cm hip, 74.00 cm chest circumference, 82.00 cm rib cage, 7.00 cm bust radius, 20.00 cm center neck to bust point, 20.00 cm. bust point to bust point, 33.00 cm chest width, 33.00 cm front waist length, 36.00 cm back width, 39.00 cm center back length, 12.00 cm across shoulder, 38.00 cm shoulder length, 78.00 cm shoulder slope, 57.00 cm arm length, 29.00 cm upper arm, 15.00 cm wrist, 34.00 cm shoulder point to elbow , 22.00 cm waist length to hip, 58.00 cm waist length to knee, 101.00 cm. waist to floor, 26.00 cm crotch depth, 70.00 cm crotch length, 73.00 cm crotch to soles of feet, 55.00 cm. thigh, and 21.00 cm ankle.

3. The bust size of Thai men was smaller than Japanese, British, and American sizes. Waist size of Thai men was bigger than Japanese but smaller than British and American sizes. Hip size of Thai men was bigger than Japanese sizes but

smaller than British and American size. Across the back of Thai men was bigger than Japanese but smaller than British size. Back waist length size of Thai men was bigger than Japanese and British sizes. The results found that Thai women bust size was smaller than British and American sizes but bigger than the Japanese size.

4. Thai women waist size was bigger than Japanese, British and American sizes. Thai women hip size was smaller than British sizes but bigger than Japanese and American sizes. Thai women across back size was bigger than Japanese and British sizes but smaller than American size. Thai women back waist length size was smaller than British size but bigger than Japanese and American sizes respectively.

5. In selection the suitable materials for Thai model construction, the results of tensile strength tests indicated that the shell fabrics A3 was stronger than A1, and A2; the interlining B2 was stronger than B3, and B1. The results of bursting strength tests indicated that A3 was stronger than A1 and A2 fabrics; and B2 was stronger than B1 and B2 fabrics. There were nine sets of combinations between the shell fabrics and interlining fabrics. The A2B2, A3B2, A3B3 were stronger than the other combinations both before and after needle punching. Consequently, A2B2, A3B2, and A3B3 were selected for Thai models construction.

6. The Thai men medium sizes models were 40.00 cm neck, 90.00 cm bust, 82.00 cm waist, 93.00 cm hip, 38.00 cm chest width, 45.00 cm front waist length, 39.00 cm back width, and 49.00 cm center back length. The Thai women medium sizes models were 37.00 cm neck, 87.00 cm bust, 71.00 cm waist, 88.00 cm abdomen, 94.00 cm hip, 74.00 cm chest circumference, 82.00 cm rib cage, 7.00 cm bust radius, 20.00 cm center neck to bust point, 33.00 cm front waist length, 36.00 cm back width, and 39.00 cm center back length. The papier-mache technique was used. The models were covered with the A2B2m A3B2 and A3B3 fabrics.

7. In model performance evaluation, there were a total of 30 evaluators. Most of those evaluators (86.67 %) were women, and a few of them (13.33 %) were men. Most of the evaluators (66.67 %) had an undergraduate level of education. A

few of them (20%) had a postgraduate level of education, and only 4 people (13.33 %) had lower than an undergraduate level of education. The income of the evaluators were as follows: There were 15 people (50%) with an income of over 15,000 bath, 10 people (33.33 %) with an income between 10,001-15,000 bath, and 5 people (16.67 %) with an income between 5,001-10,000 baht. Nobody had an income lower than 5,000 bath. The experience of the evaluators were as follows: 15 people (50 %) had experience of 3-5 years, 9 people (30 %) had experience of over 15 years, 4 people (13.33 %) had experience of 6-10 years, and 2 people (6.66 %) had experience of 11-15 years.

8. About model performance, the results indicated that the number one (A2B2) men model had the highest score concerning sizes of the model. The number two (A3B2) men model had the highest score concerning convenience of punching pin on the model. The number three (A3B3) men model had the highest score concerning tightness of fixed pin on the models. The number one (A2B2) women model had the highest score concerning sizes of the model. The number two (A3B2) women model had the highest score concerning convenience of punching pin on the model. The number three (A3B3) women model had the highest score concerning tightness of fixed pin on the models. The number two (A3B2) men model and the number two women model had higher total performance score than the number one (A2B2) and the number three (A3B3) models. The performance score of the two models was at a good level.

Recommendation

1. General Recommendation

1.1 Thai garment factories have no Thai standard sizes to use. They have been using Japanese or French standard sizes. Therefore, Thai standard sizes would become the body measurement data for pattern making and fitting of ready to wear.

1.2 Thai standard sizes models have well quality in term of tightness of fixed pin on the models and convenience of punching pin on the model, which were eligible to be made in a low price because it was made in Thailand. The model itself is the important equipment for patternmaking and fitting. Thai standard sizes and Thai models have been being a perfect database and being suitable equipment for the Thai garment industry. Thai standard sizes and Thai models are being upgraded and structured in a process of preparing the manufacturer to be the centre of excellence in the fashion industry by improving production and management.

1.3 The A3B2 was stronger than the other combination sets in both before and after needle punching. The A2 (Shell fabric) was the medium weight cotton 60 warp yarns by 60 filling yarns per 1 square inch made from 20 count yarn. The B2 (interlining) was 600 g/m 5 mm thick polyester nonwoven which was similar to the British models that were made from Linen shell fabric and woven interlining. Therefore, the two fabrics are recommended for Thai model construction.

2. Recommendation for further study

- 2.1 There should be more study in Thai children standard sizes.
- 2.2 There should be a research on Thai standard sizes model in a full length version.
- 2.3 There should be more testing in term of the usage lifetime of the developed Thai standard sizes model.

LITERATURE CITED

- Armstrong, H. J. 2000. **Pattern Making for Fashion Design**. 3rd.ed. Prentice – Hall, New Jersey.
- Brown, P. and J. Rice, 2001. **Ready – To – Wear Apparel Analysis**. 3rd.ed. Prentice – Hall, New Jersey.
- Calasibetta, C. M. 1998. **Fairchild’s Dictionary of Fashion**. 2nd.ed. Fairchild Publication, New York.
- Cooklin, G. 1990. **Pattern Grading for Women’s Clothes: The Technology of Size**. BSP, Oxford.
- _____. 1992. **Pattern Grading for Men’s Clothes: The Technology of Size**. BSP, Oxford.
- _____. 1995. **Master Patterns and Grading for Women’s outsizes**. Blackwell Science, Oxford.
- Department of Foreign Trade. 2010. **Value of Export and Imports**. [http:// www.dft.moc.go.th](http://www.dft.moc.go.th), June 21, 2010.
- Desmarteau, K. 2004. **Let the Fit Revolution**. <http://www.bobin.com>, October29, 2004.
- Diamond, J and Ellen Diamond. 1994. **Fashion Apparel and Accessories**. Delmar Publishers, New Jersey.
- Frings, G. S. 1996. **Fashion Concept to Consumer**. 5th.ed. Prentice – Hall, San Francisco.

- Guillaume, B. 2005. **Thailand Fights for Prominence**. <http://www.bobbin.Com>, February 16, 2005.
- Haggar, A. 1991. **Pattern Cutting for Lingerie, Beachwear and Leisurewear**. BSP, Oxford.
- Jamkajornkeial, K. 2002. **Cut&Sew**. TTIS. 2(12) : 51
- Anonymous. 1995. **Mandarin**. Thailand Exported, Bangkok.
- Anonymous. 2003. **Lady Boutique**. No. 370. Joie.Inc, Tokyo.
- Kennett and Lindsell. 1998. **Garment Stand Techmology**. Romford, London.
- Leeper, C. 2003. **Beginner's Guide to Sculpture**. Silverdale, China.
- Minieka, E. 2000. **Statistics for Business with Computer Applications**. South-Western College publishing, Ohio.
- Picken, B. M. _____. **A Dictionary of Costume and Fashion: Historic and Modern**. Dover Publication, New York.
- Ritnim, M. 1993. **Professional Competencies of Ready- made Garment Patternmakers Required by Exporters**. M.S. Thesis, King Mongkut's Institute of Technology North Bangkok.
- Slobodkin, L. 1973. **Sculpture : Principles and Practice**. Dover, New York.
- Thai Industrial Standards Institute. 2001. **Thai Body Structure Report, Step 4 : 2000-2001**. Ministry of Industry, Bangkok.

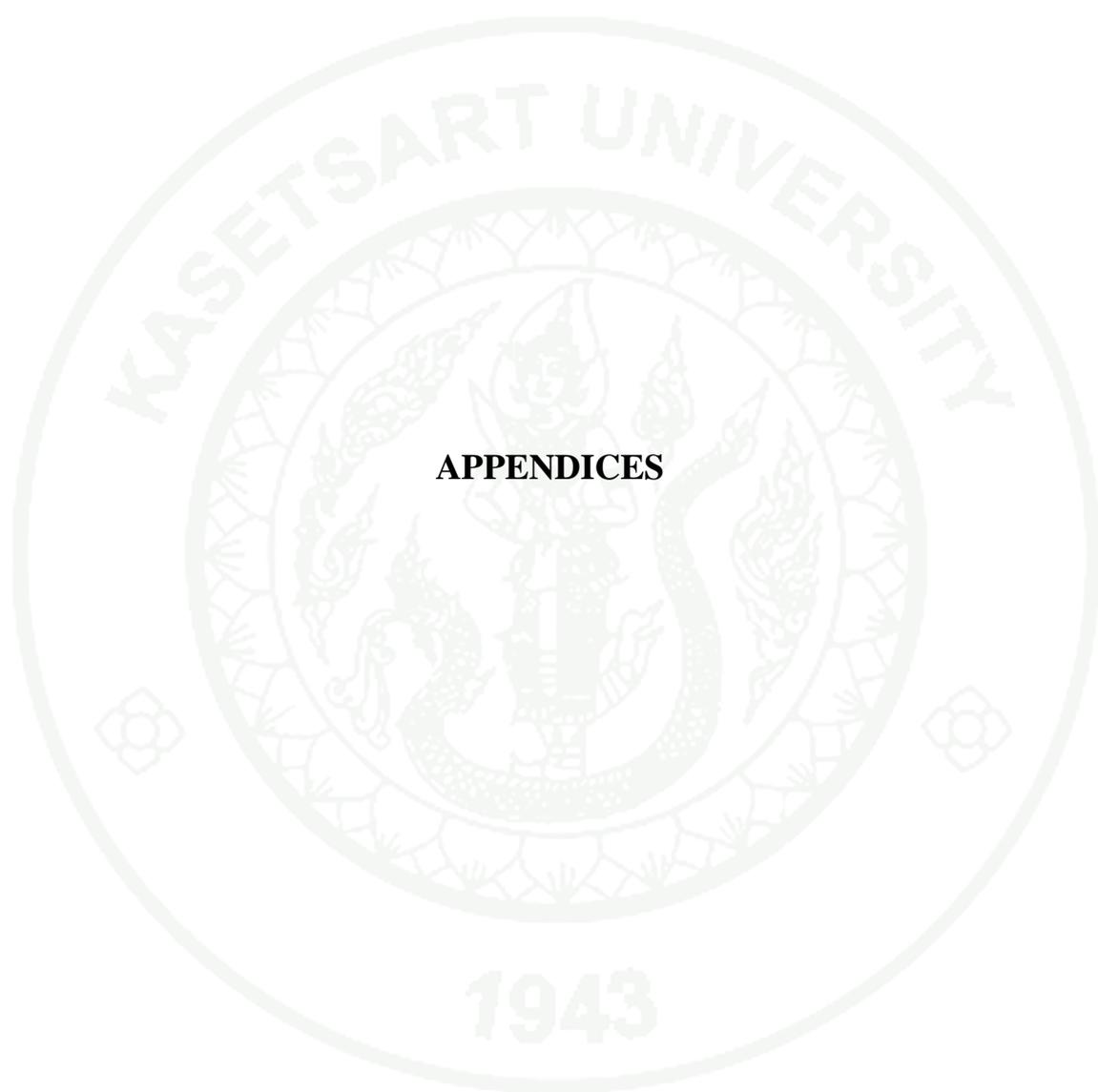
Thai Garment Manufacturers Association. 2010. **Thai Garment Exports Statistics :2010.** [http:// www.thaigarment.org](http://www.thaigarment.org), June 21, 2010.

Thailand's National Statistical Office. 2003. **Population from Registration Record by Region, Changwat and Sex : 2002.** [http: // www.mailto: webmaster@nso.go.th](http://www.mailto:webmaster@nso.go.th), December 6, 2004.

Weber, J. 1986. **Clothing Fashion Fabrices Construction.** Glencoe Publishing, New York.

Winifred, A. 1990. **Metric Pattern Cutting for Menswear.** 2nd.ed. BSP, Oxford.

_____. 1992. **Metric Pattern Cutting.** 2nd.ed. BSP, Oxford.



APPENDICES



Appendix A
Models Performance Evaluation Form

Models Performance Evaluation Form

This questionnaire is one part of the research on the development of Thai Standard Size Models. All data is confidential research only. (/ You choose the data)

Part 1 characteristics of Background

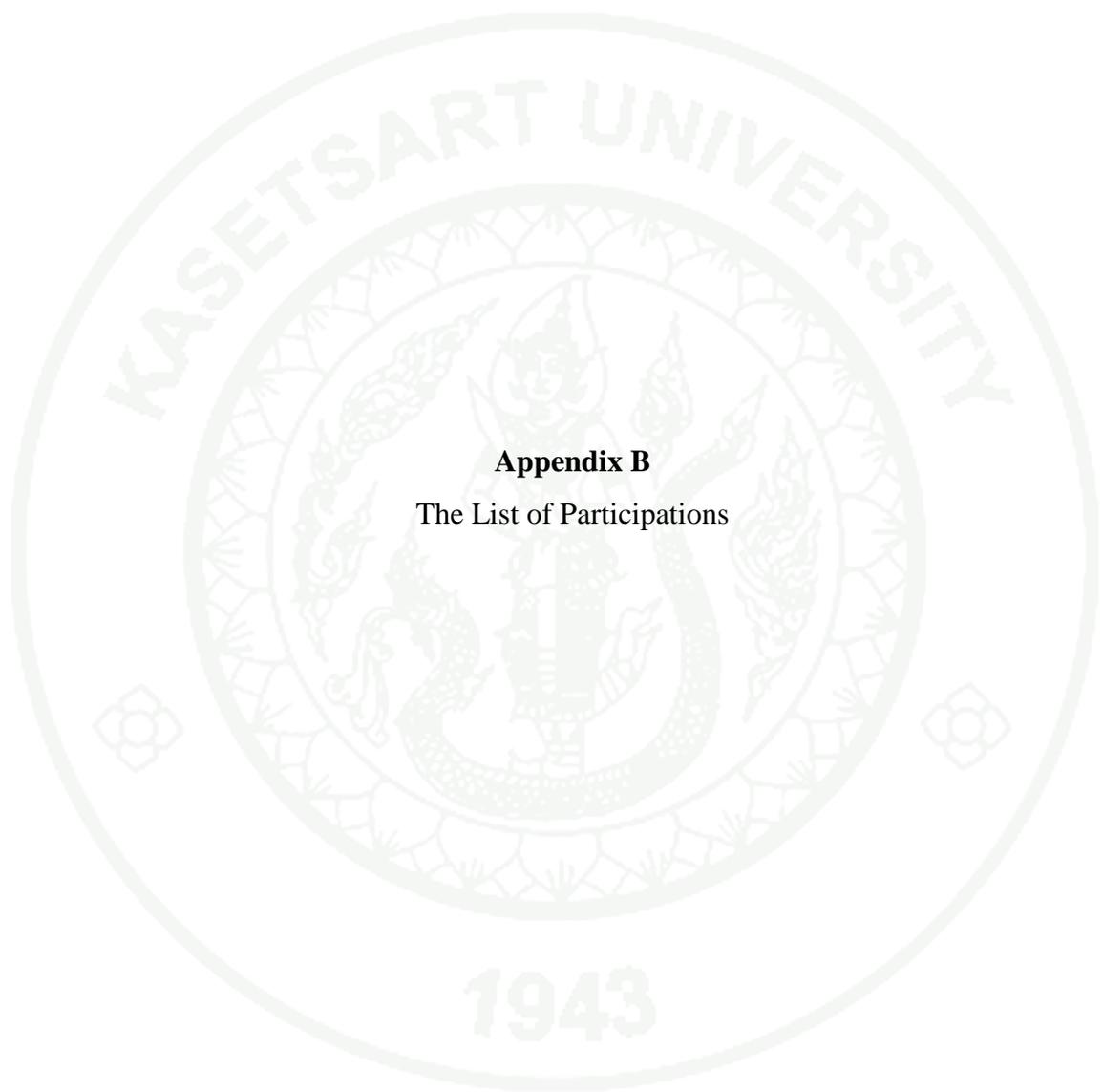
Researcher

1. Gender . Men 2. Women ()
2. Education 1.Lower Undergraduate 2. Undergraduate 3. Post Graduate ()
- 3.Income 1. 5,000 and Lower Bath 2. 5,001 – 10,000 Bath
3.10,001 – 15,000 Bath 4. Over 15,000 Bath ()
- 4.Experience 1.Years 2.6 -10 Years 3. 11-15 Years 4. Over 15 Years ()

Part 2 Models Performance Test (Size M)

1. Fair 2. Good 3. Excellent

No	Item	Satisfied Level									Remark
		No.1			No.2			No.3			
	Men	1	2	3	1	2	3	1	2	3	
1	Tightness of fixed pin on the models										
2	Convenience of punching pin On the models										
3	Total Model Quality										
4	Thickness of the Material										
5	Sizes of Model										
	Total										
	Women										
1	Tightness of fixed pin on the models										
2	Convenience of punching pin On the models										
3	Total Model Quality										
4	Thickness of the Material										
5	Sizes of Model										
	Total										



Appendix B

The List of Participations

The List of Participations

1. The Department of Textile & Clothing, Faculty of Home Economics Technology, Rajamangala University Technology of Thanyaburi, 39 Rangsit Nakhonayoi RD, Khong 6, Thanyaburi, PHATHUMTHANI 12110 Tal. 662 5493179
2. The Department of Textile & Clothing, Faculty of Home Economics Technology, Rajamangala University Technology of Phra Nalhan, 168 Sriyathaya RD. Vachirapayabal, Dusit, BANGKOK 10140 Tal. 662 2819231-4
3. The Department of Textile & Clothing, Faculty of Home Economics Technology, Rajamangala University Technology of krungthep, 2 Nangleng RD, Thungmahamak, Sathan, BANGKOK, 10120 Tal. 662 2879625
4. New World International LTD.Part. 107 Moo1 Sukhumviy Road. Kn33, soi Sangfa, Bangpoomai, Pmpur Muang, SAMUTPRAKARN 10280. Tal. 662 32396111
5. Junior Garment International CO., LTD. 44/130 Moo 11, Soi 3 Tivanont, TI vanont RD, Talard Khan,A. Aueang NONTHABURI 11000 Tal. 662 9688492
6. Jaspal CO., LTD. 1054 Soi 66/4 Sukhumvit RD, Bangjak Prakanong BANGKOK 10260 Tal. 662 7449522
7. Pataya Manufacturing CO., LTD 64/28 Soi Wadchan-Noi, Bangkok-Laem BONGKOK 10120 Tal. 662 2912390-80
8. Wacoal CO., LTD. 930/1 Soi Prodoo1, Sathupradith, Bangkhlo, Bankholaem, BANGKON 10120 Tal. 662 2893100-9
9. Boutique Newcity CO., LTD. 1112/53-75 Piyawatch, Sukhumvit RD, Prakanong-Wattana, BANGKOK 10110 Tal.662 3913311
10. Chaing Mai Technical Colleges, 9 Wiangkaew Rd., Siphum , Muang, Chiang Mai 50200 Tel. (PR.) 0-5321-7708, 0-5322-1599
11. Lamphum Technical Colleges, 42 Lamphun-Pasang Rd., Naimuang, Muang, Lamphun 51000 Tel. 0-5351-1073, 0-5356-1029
12. Saraburi Technical Collegew, PhaHonYoThin Rd., Muang, Saraburi 18000 Tel. 0-3621-1122, 0-3622-0236, 0-3621-2096

CIRRICULUM VITAE

NAME : Mrs. Srikanjana Jatuphatwarodom

BIRTH DATE : October 25, 1958

BIRTH PLACE : Sukhothai, Thailand

EDUCATION	<u>YEAR</u>	<u>INSTITUTE</u>	<u>DEGREE/DIPLOMA</u>
	1981	Institute of Technology and Vocational	BA. (Home Economics)
	1994	Kasetsart Univesity	MA. (Home Economics Education)

POSITION/TITLE : Assistant Professor

WORK PLACE : Faculty of Home Economics, Rajamangala University
of Technology Thayaburi

SCHOLARSHEP/ : Thai Government Scholarship 2004-2007

AWARDS