CHAPTER IV

EXPERIMENTAL PROCEDURE

The experimental procedure has been explained under the following subsections :

4.1 Preliminary data and preparation of fabrics used.

4.2 Chemical composition and application of finishing material.

4.3 Determination of shrinkage/dimensional changes on washing.

4.4 Determination of related physical properties:

(a) elastic recovery ,(b) tensile strenth and elongation,

(c) tearing strength, (d) stiffness, (e) wrinkle recovery,

(f) appearance rating after wrinkling and ironing.

4.5 Determination of pleat retention of fabrics.

4.6 Determination of the durability of finish.

4.7 Drafting of basic skirt and adaptation.

4.1 Preliminary data and preparation of fabrics used

(a) Preliminary data of the fabrics used

Preliminary data of fabrics on weight per unit area, thread count and thickness were determined as per standard procedures given below:

(i) Determination of weight of fabric per unit area (34b)

Specimens, of size 5.Ø cm x 5.Ø cm were cut at random from each fabric. The specimens were conditioned and weighed separately on the analytical balance. An average of five readings was taken and weight per unit area in ounce per square yard, and

grams per square meter was calculated, using the following formulas :

$$\text{Wt. per unit area (oz./sq. yd.)} = \frac{W(\text{gm.}) \times 36\ (\text{inch}) \times 36\ (\text{inch})}{2\ (\text{inch}) \times 2\ (\text{inch})} \times 1/28.4$$

$$\text{Weight (gm/sq.m.)} = \frac{W(\text{gm}) \times 100\ (\text{cm}) \times 100\ (\text{cm})}{5\ (\text{cm}) \times 5\ (\text{cm})}$$

(ii) Determination of thread count of fabrics (34c)

The number of threads per inch in the warp and weft direction were counted, using Alfred Suter Counter. An average of five readings was taken for each fabric and was reported in the metric system.

(iii) Determination of compressible thickness of the fabrics (34a)

The Compressometer was used to determine the thickness of the fabrics. A specimen was placed on the flat surface, below the pressure foot of the instrument, without any folds. The pressure foot was lowered slowly upon the specimen by rotating the knob slowly, until the upper dial read 5 (equal to Ø.1 lb. pressure per square inch) and the reading wasrecorded from the lower dial. The pressure was then increased until the upper dial read 4Ø (equal to 1.Ø lb pressure per square inch) and the lower dial reading was recorded again. The difference between the two lower dial readings gave the compressible thickness of the fabric in inches (xØ.ØØ1"). An average of five readings was taken as the fabric thickness. This was also converted to centimetres and reported to the nearest Ø.ØØ1 cm.

(b) Preparation of fabrics used

(i) Scouring of wool and cotswool fabrics

The selected commercial wool and cotswool and loom state wool fabrics were scoured in a solution containing 2 gm/l of Lissapol N and 2 ml/l of ammonia having material to liquor ratio 1.3Ø. Stapler (1Ø2) has given the scouring of wool using non-ionic detergents in neutral, alkaline and aqueous ammonia salt solution. The alkaline media of pH 8-9 was used for scouring. The fabrics were treated for 3Ø minutes at 45-5Ø °C, rinsed and dried.

(ii) Scouring of cotton fabric

The cotton material was scoured in a solution containing 2 gm/l of soap and 2 gm/l of soda ash at 8Ø-85 °C for 45 minutes with meterial to liquor ratio 1:3Ø, rinsed and dried.

(iii) Bleaching of loom state wool fabric

Scoured wool fabric was bleached with 2 vol. hydrogen peroxide with material to liquor ratio 1:2Ø. Fabric was entered in a bath containing 2 vol. hydrogen peroxide with 2 gm/l Lissapol N and ammonia to adjust pH between 8 to 9 at 45-6Ø °c. Fabric was treated for 45 minutes with gentle stirring. Fabric was taken out, rinsed thoroughly and then treated with Ø.5 per cent acetic acid to neutralize the alkali, rinsed and dried on a flat surface.

(iv) Pretreatment (acid chlorination) of wool fabric (1Ø8)

Scoured and bleached fabric was treated with Ø.5 gm/l available chlorine. Fabric was entered in a bath having Ø.5 gm/l available chlorine and Ø.5% acetic acid at room temperature.

Fabric was kept in this solution for 15 minutes with gentle stirring. After 15 minutes Ø.1 gm/l sodium bisulfite was added in the bath and kept for 1Ø minutes. Samples were taken out, rinsed and then neutralized with Ø.5% ammonia solution for 5 minutes. Fabrics were taken out, rinsed thoroughly and dried.

4.2 Chemical composition and application of finishing material

The acrylamide finish along with fomaldehyde as cross linking agent and redox pair i.e. ammonium persulphate, sodium thiosulphate and hydrogen peroxide were used for the manufacture of aqueous solution. The selection of the catalytic system was done by trying many chemicals as catalyst alongwith acrylamide in a test tube. The time taken for the solution to turn viscous, the effect on properties of treated fabric and durability of the finish was noted. No change in properties was noted using alkaline pH. In the absence of sodium thiosulphate no change in viscosity and effect on properties was noticed. Hydrogen peroxide helped to avoid the yellowness. With acetic acid, suplhamic acid change in viscosity was noted but finish was not durable. Durability fo finish was noted with trichloro acetic acid.

Table 1 Chemical composition of agents in finish recipe

Chemicals		% Finish Concentration			
		2.5%	5.0%	7.5%	10.0%
Acrylamide	gm.	2.5	5.0	7.5	10.0
Formaldehyde (40%)	ml.	3.75	7.5	11.25	15.0
Teepol (2 gm/l)	ml.	25.0	25.0	25.0	25.0
Ammonium persulphate	gm.	0.250	0.500	0.750	1.0
Sodium thiosulphate	gm.	0.250	0.500	0.750	1.0
Hydrogen peroxide (20 vol)	ml.	2.5	5.0	7.5	10.0
Teepol (2 gm/l)	ml.	68.75	62.5	56.25	50.0
Trichloro acetic acid	gm.	0.2	0.2	0.2	0.2
Total	ml.	100.0	100.0	100.0	100.0

Same redox catalytic system was tried using acrylic acid but change in viscosity was very fast and was not used for final work.

Acrylamide was used as finishing agent and was prepared in four cocentrations (i.e. 2.5, 5.0. 7.5 and 10.0%). Formaldehyde and 25.0 ml teepol (2 gm/l) was added to the acrylamide and was kept for 30 minutes. Ammonium persulphate and sodium thiosulphate followed by hydrogen peroxide and teepol (2gm/l) was added. Trichloro acetic acid was added to the above solution. This solution was stirred. The samples of each fabric were padded with the above solution separately on padding mangle with 2750 gms weight. The percent pick up was

(a) wool and cotswool - 120%

(b) cotton - 105%

with soda ash for cotton. After each wash of 40 minutes the specimens were taken out carefully and rinsed thoroughly with no distortion. It was then dried on a flat surface in warm air at 50-60 ^{o}C. After drying samples were again measured after keeping on a flat surface. An average of nine readings was taken. The percent felting-shrinkage was obtained by subtracting the percent relaxation-shrinkage from the total shrinkage. The average distance between the point on pair of marks in warp and weft directions before and after washing for each test specimen was calculated.

The percent dimensional change was calculated both in warp and weft directions.

$$R = \frac{100\ (L0 - L1)}{L0}$$

Where

R = percent shrinkage

L0 = distance between points before washing

L1 = distance between points after washing

4.4 Determination of related physical properties

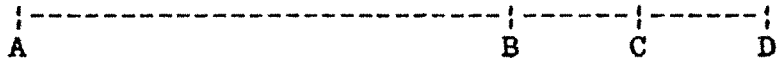
(a) Elastic recovery (4d)

The elastic recovery was determined on the Scott Tester. Samples of size 6 inch (warp) and 1 inch (weft) were cut and the warp threads wre unravelled from both sides. The samples were conditioned in a dessicator. The distance between the two jaws was 4 inch (10 cms). The samples were marked for a distance of

10 cm under 200 gm. tension. The specimen was mounted in the two jaws from the marked points and subjected to loading at 50% of the breaking load. Three load - unload cycles were repeated and after third cycle the samples were kept under load for five minutes. The reading under load was taken with the help of vernier calliper. After five minutes samples were taken out and the recovery after 5 min, 30 min, 12 hrs and 24 hrs. was measured under 200 gm weight.

The percent elastic recovery was calculated using the formula,

$$\text{Percent elastic recovery} = \frac{CD}{BD} \times 100$$



Where

AB = original length

BD = total extension

CD = elastic extension

BC = permanent set

(b) Tensile strength and elongation (4C)

The tensile strength and elongation of the fabrics was determined on the Scott Tester using ASTM method D 1682-64T. The samples of the size 6" x 1" were cut from warp and weft direction of all three fabrics. The threads were unravelled from both the sides and equal number of threads i.e. 55/55, 60/43 and 70/65 were kept in wool, cotton and cotswool fabrics in warp/weft directions respectively. This was done to get the strength data within the range of 50 lbs on the basis of preliminary work. The

samples were conditioned in a dessicator over the saturated common salt. The specimen was mounted firmly between the two jaws at a distance of 3 inch. The instrument was started by moving the lower jaw downwards till the sample broke. The breaking strength and elongation was noted from the graph. An average of five readings was taken. The percent elongation at breaking load as well as at intermediate loads was calculated from the following formula :

$$\text{Per cent elongation} = \frac{E \times 100}{L}$$

Where

E = elongation (obtained from the graphs)

L = Original length of the specimen.

(c) Tearing strength (4b)

Tearing strength was determined using the Elemendorf Tearing Tester following ASTM D 1424-63 T method. From the untreated and treated wool, cotton and cotswool fabrics samples measuring 4 x 1.25", 4 x 2.0" and 4x2.5" were cut. This variation was made as the strength was more than that could be recorded from the instrument.

The samples were conditioned. The pendulum was raised to the starting position and the pointer was set against its stop. The specimen was then fastened securely in the clamps and upper edge was parallel to the top of the jaw, and widthwise yarn was exactly perpendicular to them. By the use of the knife blade a slit of 0.7 inch was cut in the specimen extending from the

bottom edge. The sector was released to foil, thus moving the pendulum away from the specimen. The force required to tear the sample was read from the scale. The results were then calculated by multiplying factor 16, which gave the force in grams required to tear the sample. An average of five readings was taken.

(d) Determination of stiffness of fabrics (4a)

The bending cantilever method of A.S.T.M. D 1388-64 T was used for studying this property. Samples of the size 15 cm (warp) and 2.5 cm (weft) were cut and conditioned. The instrument was placed on a levelled table. The sample was placed lengthwise on the wooden plate and then it was transferred to the instrument platform coinciding the edge of the sample with zero of the scale. The wooden plate/rod was moved slowly over the 45^{o} sloped edge alongwith the strip. When the end of the strip touched the sloped surface the bending length was noted from the scale fixed on the platform of the instrument.

The same operation was repeated with the other side of the sample up and again at the other end of the sample first with the original face up and then with the sample turned over. Reading from the scale was calculated directly, in bending length in centimetres. An average of five readings was taken.

(e) Wrinkle recovery (3a)

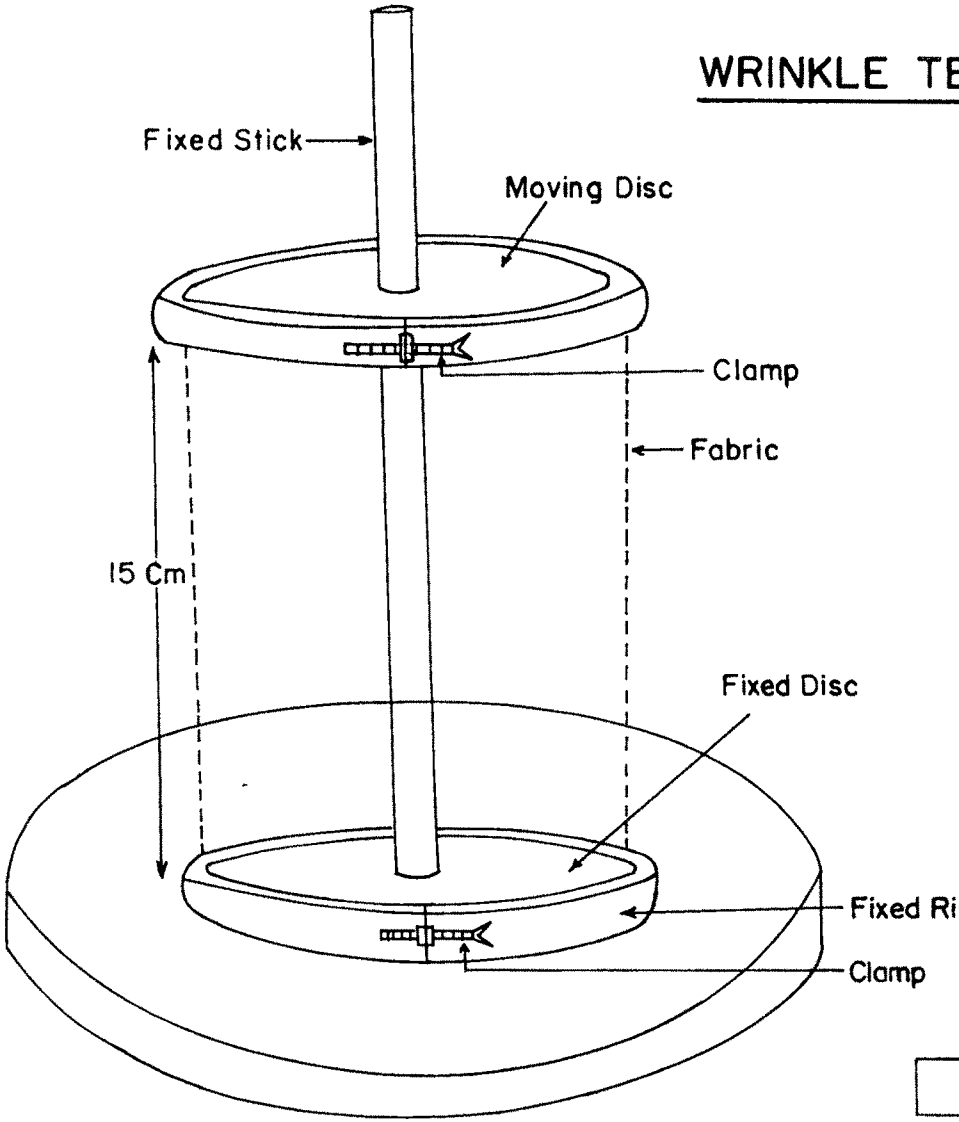
The wrinkle recovery was determined on the Monsanto Wrinkle Recovery Tester using AATCC test method 66-1984. This insturment provides an accurate way of measuring the capacity of a fabric to recover from creasing in a given time.

The treated and untreated samples measuring 4.Ø cm x 1.5 cm were cut both in warp and weft direction and were tested after conditioning. An average of 2Ø samples i.e. 1Ø warp and 1Ø weft was taken. Using a tweezer, a test specimen was placed between the leaves of the specimen holder with one end flat aginst the longer metal strip. This exposed end was folded back to the guide line of the shorter leaf and was held there firmly by inserting between the jaws of the plastic holder. The specimen was then creased for 5 minutes under a 5ØØ gm. weight. It was placed on the wrinkle recovery angle tester. The specimen holder was inserted in the clamp of the instrument. The exposed end was released and the disc was rotated till this end was aligned parallel to the vertical line at the centre of the instrument. After 5 minutes of released position the disc was again rotated for alignment, and the recovery angle was noted from the engraved scale. This was done for both the surfaces of fabric.

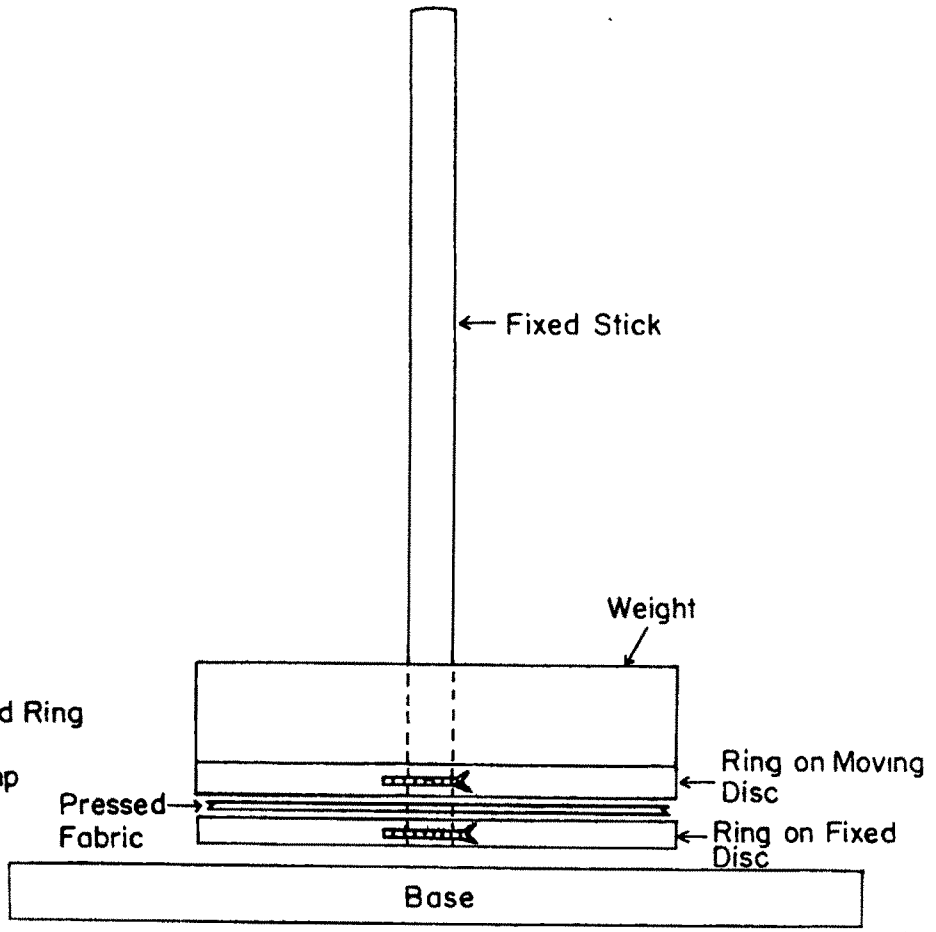
(f) Evaluation of appearance of fabrics after induced wrinkling and ironing (3d)

The principle of AATCC Test Method 128-1982 (3d) was the basis of the experiment. The apparatus used on this basis is shown in Figure 1. Three test specimen of size 28 cm x 15 cm each with the long dimension running in the direction of the warp were cut and ironed at nylon setting and then conditioned in a standard atmosphere over a saturated solution of common salt. The top wooden disc of the tester was raised and the long edge(28 cm) of the specimen was wrapped around the top disc with the face side

WRINKLE TESTER



FABRIC MOUNTED FOR TESTING



FABRIC UNDER TEST

Fig. I

of the specimen on the outside. The specimen was clamped with a wooden ring with screw. The other edge of the specimen was similarly fixed around the bottom disc. The specimen was adjusted by pulling at the bottom edge, so that it was smooth without sagging between the top and the bottom discs. The top disc was gently lowered with one hand till it came to rest. The two discs were then covered with a cut tin box and a total of 3,500 gm. weight was placed on the top of the box. After 20 minutes the weights and the box were removed. The top disc was raised gently and the specimen was removed from the tester so as not to distort any induced wrinkles.

The specimen was then hung on the screen with a hanger having adjustable clips. The background of the screen was grey and the wrinkles were observed under an overhead fluorescent lighting system at an angle of 15°. The total height from the floor to the light was eight feet and the distance of the sample from the floor was five feet.

The observer stood directly in front of the test specimen, four feet away from the screen. For comparison, two photographs of three dimensional replicas were hung on each side of the test specimen to facilitate comparative rating. Equal portions of the photographs of three dimensional replica to the fabric specimen size was only exposed for comparison, the remaining part being covered with grey paper sheet. These photographs were changed by the investigator as desired by the observer. Each test specimen was independently evaluated by three raters and assigned the

number of the photographs of replica which most nearly matches the appearance of the test specimen. Test specimens were again rated by the three observers after twenty four hours.

To see the influence of the weight of the iron alone, each test specimen was ironed flat with cold iron for 10 seconds each on face and back side of the fabric. The test specimens were then again rated by three observers.

To see the ease of ironing, each test specimen was ironed flat with iron at nylon setting using the same procedure as for cold iron. After ironing, the test specimens, were rated again by the three observers.

The fabric smoothness ratings are:

No.1 Rating was equivalent to standard 1 and represented the poorest appearance and poorest retention of original appearance.

No.2 Rating was next to No.1

No.3 Rating was next to No.2

No.4 Rating was next to NO.3

No.5 Rating was equivalent to standard 5 and represented the smoothest appearance and best retention of original appearance.

4.5 **Determination of percent set retention of pleats**

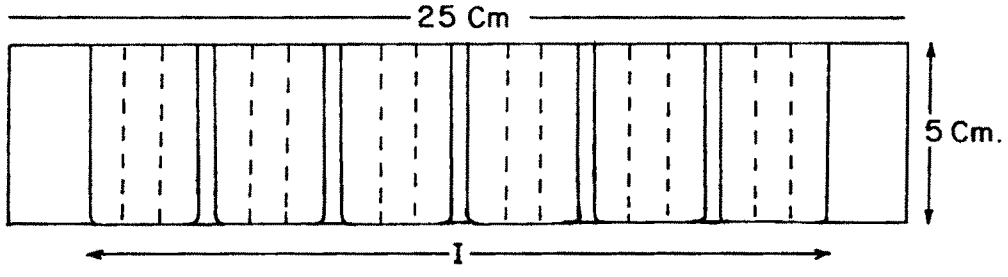
The procedure was modified on the basis of the experiment done by Cook and Delmenico (17), on permanent press effects on wool. Fabrics were padded with varying concentration of finish,

partially air dried and cut into strips of 25 cm (weft) and 5.Ø cm (warp) which were already marked. The strips of fabrics were formed into a series of 1 cm x 2 cm knife pleats leaving Ø.5 cm distance between two pleats to avoid overlapping. This distance was taken as a correction factor at all levels. These pleats were held in place by stitches. Samples were kept in between 2 foam layers with two glass plates on both sides. Two wet cotton pieces with 1ØØ% pick up were kept on both sides of samples to keep samples moist. This assembly was kept in oven at 1ØØ-12Ø °C for 3Ø minutes under 5ØØ gm weight for setting. Samples were air dried and cured at 12Ø °C for 1Ø minutes. The stitches holding the pleats were removed and the length of the wool and cotswool samples was measured after releasing them in water for 5 min at 5Ø °C and cotton at 7Ø °C and after machine washing wool and cotswool in 2 gm/l teepol at 5Ø °C and cotton at 7Ø °C, after drying.

After washing the length was measured and the distorted pleats were again formed and allowed to dry on a flat surface at 5Ø-6Ø °C. The samples were then hung vertically and after five minutes the length was measured in the hanging stage.

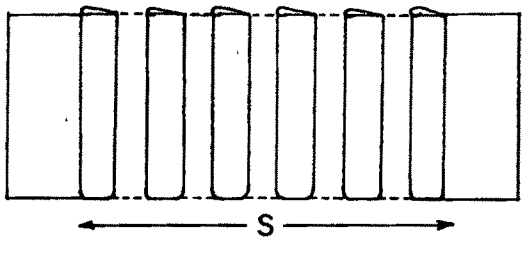
The percentage set retained after the various conditions of release was calculated from the formula:

DIAGRAMATIC REPRESENTATION OF SETTING OF PLEATS



(20·5 Cm.)

Fig. 2(a)



(8·5 Cm.)

Fig. 2(b)

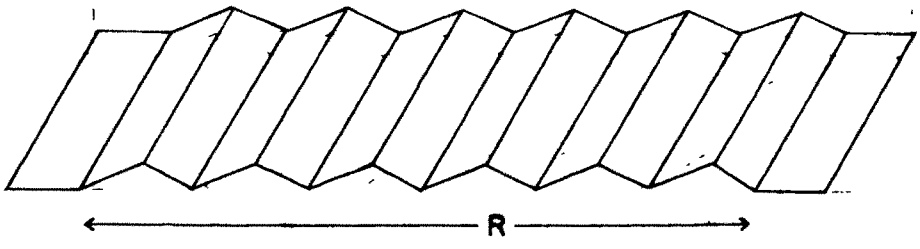


Fig 2(c)

I - Initial Flat Length

S - Length at Pleated State

R - Released Length

Fig 2

$$\text{Set} = \frac{100\ (I - R)}{I - S}$$

Where

R = distance between pleats after release

S = distance in the pleated state

I = length in the initial flat state

4.6 Determination of the durability of the finish (2)

Durability was assessed by washing the samples with 2 gm/l teepol and 2 ml/l ammonia using material to liquor ratio 1:20. Samples were kept in the solution, with occasional stirring for 30 minutes maintaining the temperature at 45-50° C forwool, at 70-75° C for cotton and 55-60° C for cotswool fabric. The samples were then washed under running water, dried and conditioned.

Percent weight loss was calculated and changes in properties were assessed before and after washing.

From these results, durability of the finish in general was ascertained.

4.7 Drafting of the basic skirt and its adaptation

(a) Drafting of basic skirt

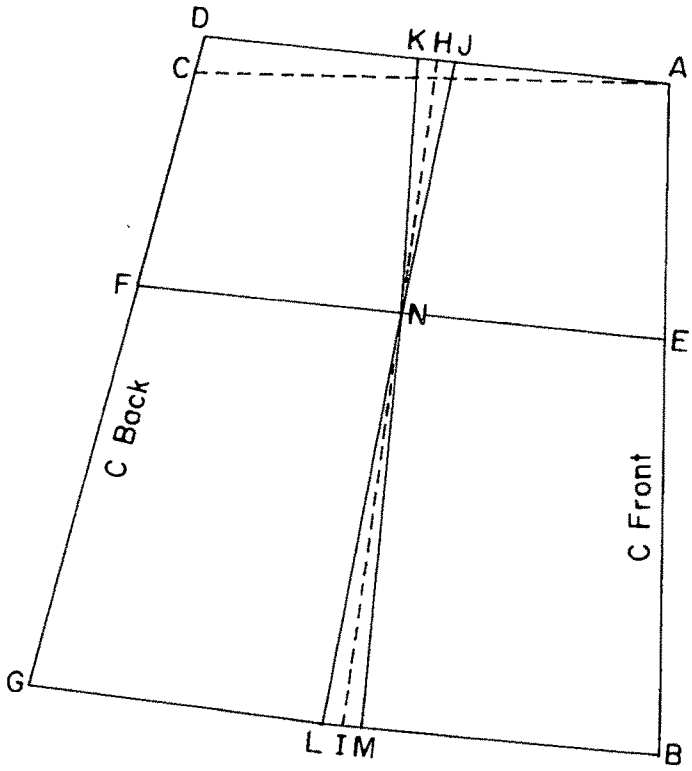
Drafting of basic skirt was done as per instructions given by Bertha (81). Some modifications were made, namely the darts were eliminated from the waist and A line shape was given only on the sides, the difference between waist and hip measurements being only 9 cms. The measurements used were taken from the previous anthropometric study of Lamba (70).

Measurements required:	cms
Ready length of the skirt	37.Ø
Round hip	57.Ø
Round waist	48.Ø
Waist to hip	14.Ø

The front and back slopers were drafted together and then separated.

- Draw the finished centre front length (A-B)
- Draw waist line (A-C) one half of the complete hip measurements minus 2.5 cm.
- Mark C to D equal to 2 cm.
- Curve waistline from D to A.
- Draw (A-E) equal to hip level measurement on AB line.
- Draw (E-F) equal to one half of the complete hip measurements plus 1 cm parallel to waist line.
- Draw centre back line (D-G) through C and F, upto waist line and down towards hem.
- (D-G) is equal to skirt length
- H is the centre of waist line (A-D).
- I is the centre of hem line (B-G).
- Join H-I with a dotted line through N.
- AJ = D K = One fourth of the complete waist measurements.
- IL = IM = 1 cm
- Shape side seam of front from J to N and continue to M.
- Shape side seam of back from K to N and continue to L
- Check length of seam K-L and make it equal J-M.
- Curve hem line of back from G to L and join with B.

DRAFTING OF BASIC SKIRT



Scale - 1/4

Fig 3

(b) Adaptation of skirt from the basic sloper

Only the front sloper was used to construct half skirts. The half skirts were stitched with knife pleats. A band was attached at the waist level and this length was deducted from the total length of the skirt. At hem level the skirt width was increased by 5.Ø cm, (i.e.M-M′) on each side to give A line effect.

The waist measurement for half skirt was 24 cm. Five knife pleats 2.5 cm each, were put. For making knife pleat 3 times the width of pleat was required which was 5 x 2.5 x 3 = 37.5 cm. Points for pleats were marked at a distance of 2.5 cm each. Knife pleats were made by pressing a fold to one side. A waist band of 2.5 x 24 cm was attached.

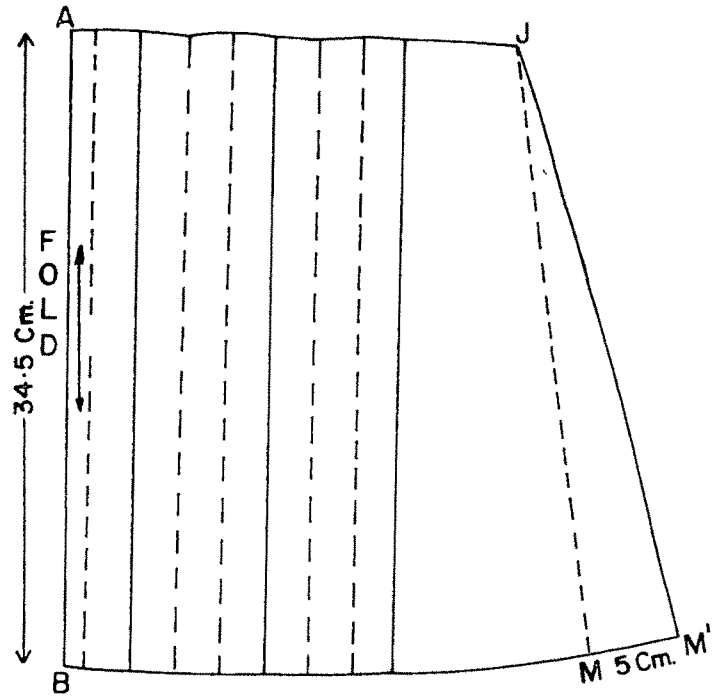
(c) Application of the finish

Fabrics wool, cotton and cotswool were padded with five percent acrylamide finish, air dried and formed into half skirts. After stitching half skirts were moistened with a spray method and allowed to hang on a wire to drip out extra solution, if any.

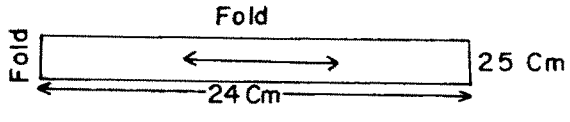
Procedure

The experimental work done on fabric samples was used for skirts also. The experimental work done on fabric samples has shown that heat in the presence of moisture helped in setting especially for wool and cotswool fabric. Skirts were kept in between two foam layers, previously kept in oven. Two wet pieces with 1ØØ% pick up were kept on both sides to keep the skirts moist. This assemble was kept in oven under 5ØØ gm weight at 1ØØ-12Ø ^{o}C for 3Ø minutes. Skirts were taken out, line dried, and

ADAPTATION FROM FRONT SLOPER



Scale - 1/4



WAIST BAND

Fig. 4

ironed at rayon temperature with flat ironing to remove wrinkles, if any and cured at 120° C for 10 minutes. Skirts were taken out from the oven, rinsed, dried and tested for the retention of pleats in original form, under static release at 50° C, after washing in launder-Ometer and after drying.

(a) Release in original form

Skirts were pinned on a model (dress form) at the waist line and allowed to hang under own weight for five minutes. After five minutes the distance between five knife pleats at hem was measured and percent retention was calculated.

(b) Static release

Skirts were laid in a tray with 5 cm level of water at 50° C for five minutes. After five minutes distance between five knife pleats was measured and percent retention was calculated.

(c) Washing of skirts

To assess the retention of pleats the washing test was carried out using the launder-Ometer. Launder-Ometer is an instrument manufactured by Atlas-Electric Devices Co., Chicago. It has been widely adopted because it is well designed to control the mechanical and physical factors that affect the washing process (2).

Big plastic jars with a capacity of two litres were taken. These jars with test specimen (half skirts) were rotated in 2gm/l soap solution for 20 minutes at 50-60° C for wool and cotswool and at 70-80° C for cotton. The material to liquor ratio was kept

1:2Ø. The skirts were removed from the jars after 2Ø minutes, rinsed thoroughly and hung on aline with clips. The distance between five pleats was measured and percent retention was calculated.

(d) After drying

After measuring the distance in wet state, skirts were laid flat to dry. After complete drying skirts were pinned to the dress form at the waist and allowed to hang under its own weight for five minutes. After five minutes the distance between five pleats was measured and percent retention was calculated. The half skirts have been shown in the photographs.