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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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EVALUATION OF FINISHED FABRICS [1]

A.D. Ferguson *

A.M.C.T. F.T.I. F.C.I. F.S.D.C.

* Controller of Research to the Great Universal Stores Group of Companies, Research Laboratory, Manchester, UK.

[1] The views and opinions expressed in this paper are those of the author and do not necessarily reflect the views of the Secretariat of UNIDO nor of his company.

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INTRODUCTION

This paper, as the title states, is concerned primarily with finished fabrics. It is patently obvious that in order to have something worthwile to finish, tests must be established to ascertain the viability of a cloth. These tests will be referred to giving details of traditional and modern cloths. Another point, which is not appreciated as often as it should be is that cloth is not the end product, but must be made into something before it has any value. Whether it be an item of clothing or an industrial material governs very much the specific finishing requirements which are needed. The question of which finishing processes to employ is very much dependent on what is going to happen to the cloth afterwards, and how much money people will be prepared to spend on it.

I. ACCELERATED TESTING

The evaluation of a product in effect means the establishment of its fitness for the purpose for which it is intended. The easiest way of doing this is to try it, but usually this is too long an operation. Consequently, laboratory tests have been developed over the years to provide this information more quickly. Such tests started in most cases from an empirical method designed to reproduce the conditions of use in an aggravated form. Many tests still operate in this way, but in order to communicate the results widely in an understandable form, the test methods themselves have been standardized. Unfortunately, in a few instances, people have become so engrossed in the reproducibility of the result that they have quite forgotten why the result was required in the first case. Bearing in mind the above, it is evident that the interpretation of results is of as much, or more, importance than the means by which they have been obtained. Since all evaluation testing is costly to operate, simple tests and inexpensive instruments are preferred when it is possible to use them.

II. FABRICS

Conventional woven and knitted fabrics have been available for many years, their construction and properties being dictated by the available natural fibres. In the course of time, machinery has replaced hand operations, and the development of man-made fibres has introduced new horizons and an infinite variation of finishing procedures. The careful blending of natural and man-made fibres has enabled materials to be produced which would not have been thought possible years ago.

Before describing the various quality standards and test methods required in finishing, let us summarize the different general types of fabric currently available, together with a simple list of finishing processes applicable to them. In doing this, let us not forget that in the final product, various types of fabric and finish may be used in conjunction with one another. These must all be compatible in their behaviour in use, and in washing or cleaning.

Examples of materials:

- Woven
- Knitted - various types
- Composite - tufted
  - sew in ([illegible])
  - malimo
  - arachne etc.
- Needled
- Bonded materials (commonly called non woven).

Examples of finishes:

- Scouring
- Bleaching
- Mercerising and ammonia process
- Raising
- Dyeing
- Printing
- Special finishes:- Durable press
  - Soil releasing and soil resistance
  - Antistatic
  - Flame retardants
  - Shrink resistance
  - Water repellents

III. CRITERIA FOR EVALUATION

Woven and knitted fabrics are normally judged by their weight per unit area, this being a simple and significant figure. Weight per lineal yard can be misleading, since if the cloth is wider, it will appear to be heavier, whereas it is in fact lighter. Also, in most cases the extra width cannot be economically incorporated into the cut of the garment. The construction of the fabric is also important, i.e., the counts of the yarns used and the number of threads or stitches per unit of distance. These principles are common to nearly all fabrics and countries, though the terminology and the units will differ.

IV. END-USE SPECIFICATIONS

The remaining standards and tests are usually referred to as "end-use" specifications. These usually consist of a series of requirements based on experience of product failure in the past. The severity of the specification being governed by the end-use, not the type of cloth. Typical examples are strength, shrinkage, dye fastness etc.

Many specifications, including our own, are based on this type of specification which operates on the assumption that the more severe the treatment in use, the more robust must the material be. An excellent example of this type of specification are those produced by the L22 Committee in America. Such a method of preparing specifications permits a wide range of materials to be used for a similar purpose.

V. CONSTRUCTIONAL SPECIFICATIONS

Where strict price considerations and standardization of fabric are important, it is common to stipulate in some detail the width, weight and construction of the fabric in addition to the performance tests.

A few words should be said about strength tests. First of all, a strength test does not provide absolute values. The results obtained will vary depending on several factors, such as the type of machine, i.e. is the load applied at a constant rate or does the machine jaw travel at a constant speed? Some machines operate with the jaw covering the whole of the width of a prepared strip. Others have an upper jaw only one inch wide, whereas the lower jaw is three inches wide. This latter test approximates more closely the common conditions of breakdown, i.e. someone grabbing at the cloth. As stated earlier, however, the determination of the required result is usually based on evidence of the danger level at which complaints of breakdown are to be expected. Strength testing is a valuable tool in the simple assessment of chemical damage in textile finishing. Since the development of durable finishes, it is often not possible to use the chemical method of assessing chemical damage by measuring the fluidity of cuprammonium.

VI. DYE FASTNESS

It is when one tries to assess some of the other properties that big problems arise. For example, dye fastness was quoted earlier as a necessary requirement - dye fastness to what conditions, and how fast? To answer these questions, we must break down the various possible types of failure and quantify them in some way. For example, a dye may have a very poor rub fastness either in the dry or wet state. This will obviously result in the cross staining of any light coloured material which rubs against it. A very simple test for this is to rub the cloth with a white handkerchief with a forefinger inserted inside the handkerchief. If the handkerchief is then wetted in the mouth, the exercise can be repeated in the wet state. Examination of the handkerchief will soon show if the material is satisfactory or not. It is common for the results to be quoted to several people such a distance apart that they could not all examine the stained handkerchief. Accordingly, standard rub-testers or crockmeters are available, which act as a rather expensive finger. A common source of trouble at present is colour being transferred from garments, usually when wet, to P.V.C. suites of furniture. This can be an expensive failure since there is a dye affinity with the vinyl which makes it difficult to remove.

Grey scales, numbered 1 - 5, are used in all dye fastness testing involving loss of colour or adjacent staining. These consist of five pairs of grey chips which in No. 5 are similar in shade, and in No. 4 one is lighter, No. 3 is lighter still and so on to No. 1 so that No. 1 is the lowest fastness and No. 5 maximum fastness, with each number being twice the previous one. The scales are used for the assessment of change of shade. Where the liability to cross staining is concerned, No. 5 scale consists of two white pieces of board with Nos. 4, 3, 2 and 1 having progressively darker pieces. The test patterns are compared with these by mentally changing them to grey and quoting the corresponding number, which is understood internationally.

Materials can cause cross staining when wet, especially clothing and furnishings. In order to check on this property, a sandwich of two appropriate materials is made, with the test specimen between in the middle. The composite specimen is placed in a petri dish, water poured in, and the surplus emptied, so as to leave damp specimens, the whole being weighted down with a square of plate glass. This test is particularly important in view of the increased use of coin-operated washing machines where the washing is often brought home incompletely dried, and left for some time in a bag or basket. During this time, serious cross staining can take place with nylon, for example.

A similar system is employed for perspiration fastness. For this purpose, acid or alkaline perspiration is used, the latter usually being the more severe. The perspiration is not obtained by making the lab. assistants run up and down stairs — it is prepared chemically.

We now come to the area of probably the greatest controversy, namely wash fastness. Before wash fastness can be quantified, it is necessary to define washing. Just as the materials being washed have increased in complexity from the traditional cotton and wool fibres, so have the washing treatments from the traditional soap and hot water. A study of the behaviour of textile materials in washing is very important if adequate assessment of the wet finishing processes is to be made. Since we have been speaking of dye fastness, we should now consider the available tests for wash fastness.

The generally accepted I.S.O. wash fastness tests involve the use of soap, or soap and soda, in some cases together with a number of steel balls to provide mechanical treatment. When detergents became common, the main constituent known to have an adverse effect on dyes was sodium perborate. Since there was already a test to assess sensitivity to this oxidising agent, and most of the dyes affected by it were known, there seemed to be no need for changing over to detergents, although a number of people did so. It was then found that, in general, disperse dyes tended to show more staining of adjacent fabrics when washed in detergents, than was the case with soap solutions, due to the sequestering effect of the soap, which prevents redeposition of the dye in solution.

American and French interests have put forward a new series of tests, covering a wide range, including the effects of chlorine bleach, which is seldom used in the United Kingdom. These new tests also increase the number of metal balls, with a view to checking on the effects of mechanical action. This is considered to be important in view of the increased use of pigment prints. Further developments have included the use of a multifibre strip of material, in order to assess the amount of staining to be expected on a range of materials. In our laboratory we use white nylon and knitted material and white cotton sheeting as adjacent fabrics, since these are the materials which are most commonly the subject of complaint from customers. An investigation on a fairly wide range of materials known to be of border-line fastness was carried out, the results of which are set out in Figure I.

The results of these tests did confirm that slightly more severe staining was to be expected with detergents than with soap. Other tests demonstrated that the extra metal balls were ineffective in discriminations against poor pigments. The question of [illegible] detergents is not altogether simple, since these powders vary between brands and between companies and are deliberatly formulated to cater for the varying requirements of hard and soft water areas. The tests which have been made employed a 'test detergent' which was an average composite product without sodium perborate. The latter was added in appropriate amounts to the wash liquor, since it loses its oxidising effect if not freshly prepared. A [illegible] hand wash with a scrubbing action was found to be much more effective. These tests also indicate that liquor ratio is a very important factor.

VII. CARE LABELLING

The question was asked "what is washing"? To a considerable extent this question has been answered in Britain by the Home Laundering Consultative Council, who produce a range of eight wash sequences of varying severity, appropriate to the various types of textile material.

This system has been broadened somewhat and now constitutes an I.S.O. care labelling code. It is already perfectly feasible to make an assessment of adequate performance in respect of loss of colour or of bleeding in washing. Consideration should be given to the fact that grey scale performances below 4 are readily perceptible to the layman. It is for this reason that 4 is our pass level. Variable behaviour is catered for by reducing or increasing the severity of the wash process.

VIII. OTHER EFFECTS OF WASHING

Colour is not the only property which is affected by washing. The size, shape, smoothness, crease retention and seam pucker are all affected by the type of washing which the garments have undergone. Washing machines, being mass produced instruments, are variable in the severity of their action, which is aggravated by the different ways in which the load is put into the machines and the different methods by which the liquor and goods are agitated. Specifications have been drawn up for a "standard" washing machine which is often used for test purposes. Since the question at issue is whether or not the materials will behave satisfactorily in the customer's machine, it would seem reasonable, as well as a lot cheaper, to use a widely sold machine in the country concerned.

The method of drying is also important. In laboratory work it is quite common to dry flat, but this bears little relation to the housewife's treatment, which will more likely consist of spin drying followed by line drying or, increasingly, tumble drying. We have found that tumble drying tends to give slightly higher shrinkage results, sometimes of the order of ½ - 1%, which can often be reduced by ironing or pulling to shape, a legitimate method only if normal pressures are applied.

An increasing number of garments, sheets etc., are now being sold which require no ironing or only very minimum ironing, and it is in this area that there is a variety of methods of assessment.

We are probably all familiar with crease recovery angle testing, both dry and wet, but comparatively few will be able to make complete assessments of future behaviour from these tests alone. There has recently been an increase in the pressure and relaxation times to five finutes, on the grounds of greater reproducibility of results. Since the test is chiefly to benefit in process testing, the shown accuracy hardly justifies a five fold increase in costs. Having said this, it is vital to remember that high crease recovery figures usually indicate an inverse proportion of abrasion resistance and tear strength.

These latter properties can be assessed on the Martindale or other machines, and several methods of testing for tear strength are available. In our case, we use the Elmendorf.

IX. SMOOTHNESS EVALUATION

In Sweden, valuable indications of creasing, or more correctly crumpling, have been shown by pushing the fabric into a Teflon tube. The proprietors of a well-known shrink resist process have developed a profile measurer of smoothness. In my opinion, the best assessments of smoothness, crease retention and pucker are those produced by the AATCC as a consequence of the development of the durable press process. These employ photographs of variably creased fabrics on a geometric scale of 1 – 5 (on the same principle as the grey scale) and are compared with washed garments, examined in an oblique light to throw up the shadows, and are very easy to use and give sensible lines of demarcation. As a matter of interest, one of the most important contributions made by the Koratron process was the fact that it caused clothing machinists to make properly balanced seams.

A word of warning might not be out of place here. Heat setting of Polyester/Cotton fabrics commonly takes place at 180°C, while in garment production underpressing, during which the seams are opened up at the back, the irons used are normally operated at 150°C. Over-enthusiastic seam bursting or low temperature heat setting will result if the setting temperatures are being exceeded, with the consequence of severe seam pucker. The desirable state of affairs is about 3/4 – 1% shrinkage of the seam, which levels up the sewing pucker. Testing for shrinkage of polyester/cotton blends, as well as for colour change or sublimation of the dye, can be carried out on a Fixotest machine, which consists of three pairs of metal plates with very accurate individual temperature control.

X. LIGHT FASTNESS

This property can be assessed in daylight but such a method is slow. It is more common to use a suitable fading lamp such as the Xenotest or Fadeometer, and make comparisons of fading with known dyeings, which are geometrically graded 1 – 8.

XI. CO-OPERATION WITH OTHER INDUSTRIES

We have mentioned standards frequently. In most cases, the standards have been evolved to check on the adequacy of some process without necessarily taking into account what will subsequently happen to the cloth. I would like to make a plea for cloth manufacturers, finishers, garment manufacturers and the people who wash and clean garments, to co-operate more fully in producing compatible materials.

XII. SOIL REPELLENCY

There are several proprietary finishes which are used to provide resistance to soiling and/or ease of dirt removal in washing. There have also been many attempts to quantify their efficiency by standard methods. None of these have been completely valid because of the infinite varieties of soiling which can take place.

Moth methods involve tumbling the test specimen together with a "standard" soil, either in powder form or impregnated into cubes of felt or similar substances. Since many stains, and consequent attraction of dirt, are due to the presence of oil or grease, tests are available to check the resistance of finished cloth, treated with flurochemicals, to oils of varying viscosity.

In ordinary life, contaminants always seem to be perversely non-standard so we are left to check for the normal hazards and make careful use of the word "resist" instead of "proof" in any advertising matter.

XIII. ANTI-STATIC

The same applies to anti-static treatments. The customary method of testing for this property is to induce a charge and measure the static produced. This can be done electrically by means of instruments or simply by rubbing the material in question with a piece of nylon cloth wrapped around a block of polystyrene. This exercise is repeated, using other fabrics. It is important also to check the degree of cling produced by these treatments when the test strip is suspended from the top of an inclined piece of stainless steel at three relative humidities, going as low as 3%. Some degree of anti-static treatment is desirable on most synthetics of a light shade, to reduce dust deposition.

XIV. FLAME RESISTANCE

This property is the subject of another paper but is very topical. Most tests are arranged to simulate the particular hazard of fire. A nightdress, for example, has a flame applied to the bottom of a suspended strip of material or applied horizontally against an inclined specimen to imitate the garment hem coming in contact with a flame. The same applies to curtains. Fireside rugs have an imitation hot coal dropped onto them in the form of a red hot nut or a chemical flame pill. These have limitations and a new draft specification has been produced in an attempt to produce better results. The instrument used for testing, however, is expensive and bound to increase the cost of the material.

XV. SHOWER PROOFING

These processes are evaluated in a variety of ways. (1) Drop test in which drops of water fall from a height onto the test pattern. (2) Spray rating water is allowed to pass onto a sample through a rose similar to that on a watering can. Fastened to an embroidery ring type of holder which is again at an angle, the amount of water which wets out on the fabric, as distinct from that which rolls off in globules, is assessed in comparison with standard pictures. A commonly used machine - the Bundesmann instrument - simulates a rain shower onto four samples. These samples are secured to the tops of four metal pots in much the same way that papers are fastened on jam pots. These pots move round while their undersurface is rubbed to induce capillary action in the same way as one's arms rub the inside of the raincoat. The amount of water penetrating the cloth is measured, as is the percentage of water absorption. An instrument has recently been introduced by WIRA which has a more controlled water supply system and dispenses with the rotating pots, claiming more reproducible results. Thime will tell which is the better system.

XVI. NEEDLE PUNCHING

There has been a considerable increase in the use of needle punch systems for floor coverings and blankets. In the latter case, a web of fibres is conveyed through a punching system supported either by warp yarns or a scrim fabric. The barbed needles operating from both sides entangle the fibres with one another and with the warp or scrim. The finishing of blankets made on this system is very important. The raising applicable to a woven fabric is too drastic. What is required are several mild runs just sufficient to produce the required surface. Any stronger action will reverse the work of the needles and pull out the fibres. Useful means of checking are by strength tests in both directions, a Martindale wear test with the test fabric on the base plate instead of the holder, and washing. Insufficient or excessive needling or excessive raising will give poor results for these tests.

XVII. SPECIFICATIONS AND REFERENCES

Most countries have their technical organizations which provide information and technologists for the standardization of test methods. In the UK, for example, we have the Textile Institute and the Society of Dyers and Colourists. The British Standards Institute is the official body for the preparation of specifications in Britain and is usually guided by the above mentioned technological and professional bodies.

The American system operates broadly in a similar manner with the American Society for Testing Materials, and the American Association of Textile Chemists and Colourists.

The I.S.O., to which reference has been made, is the International Organisation for Standardization which in 1973 comprised the national standards bodies of 73 countries. The work of I.S.O. is aimed at world wide agreement on International Standards with a view to the expansion of trade, the improvement of quality, the increase of productiivity and the lowering of prices. No small task with such diverse national outlooks.

Examples of useful books of reference are British Standards Handbook No. 11 1974 and the Handbook of the A.S.T.M., and most other countries have some publications which will be found to be helpful, as I hope this talk has been.

XVIII. SUMMARY

There has been considerable sophistication of textile products and finishes. As a consequence of this it has become necessary to devise or improve tests so as to provide consumer satisfaction. This has become increasingly necessary, for example, in relation to the techniques of washing.

The use of various domestic washing and drying machines and the availability of larger coin-operated washing machines has been further complicated by the variety of available washing powders. In this respect, the current International Standards Organization specifications based on the use of soap and/or soda, are under review.

Washing not only affects dyes but also can result in creasing, seam pucker and loss of shape. Test methods have been developed which can quantify these properties with reasonable accuracy.

There are two basic types of specification relating to finished textile products:

1) End-use specifications, which lay down the performance requirements relative to different end-uses, thereby permitting alterntive fabrics to be used;

2) Constructional specifications, which are laid down to produce substantially identical cloths known to be suitable for a specific purpose.

There are various tests and standards applicable to these various specifications which usually start in individual countries.

The official standard organizations of some 73 countries then reach agreement of an international standard.

The final need is for greater co-operation between fabric producers, finishers and clothing manufacturers.

COMPARATIVE TEST RESULTS EXPRESSED IN ISO GREY SCALE RATINGS

PATTERN CARD:

TEST:

		A			B			C							D						
		ISO 2 0.5% SOAP SOLUTION			ISO 2 4gl WOB DETERGENT 1 gl SODIUM PERBORATE			AS B							ISO/TC38/SC1(UK.SEC 102)587.23 4 gl WOB 1 gl SODIUM PERBORATE						
ADJACENT FABRIC:									MULTIFIBRE STRIP							MULTIFIBRE STRIP					
FABRIC	COMPOSITION	E.P.	NYLON 6	COTTON	E.P.	NYLON 6	COTTON	E.P.	A	B	C	D	E	F	E.P.	A	B	C	D	E	F
Pink blanket	Acrylic	4	3-4	4-5	4	2-3	4	4	4	4-5	4	2-3	4-5	3	4	4	5	4	2-3	4-5	3
Blue knitted	Acrylic	5	4-5	5	5	5	5	5	5	5	5	5	4-5	5	5	5	5	5	5	5	5
Tweed effect Woven	Acrylic, wool viscose etc.	4-5	3-4	4-5	4	3-4	4	4-5	4-5	5	4-5	3-4	3-4	3-4	4	4-5	5	4-5	4	4	4
Maroon Cord	(Cellulose (triacetate & nylon	5	3	4-5	5	3	3-4	5	4	4-5	3-4	3	4	2-3	5	4	4-5	3-4	3	4	2-3
Dark pink woven	Wool & viscose	1-2	4	3-4	1-2	4-5	3	1-2	4-5	4-5	4-5	5	3-4	5	1-2	4-5	4	4-5	4-5	3-4	5
Blue woven	Polyester & viscose	5	2-3	4	5	3-4	4	5	4-5	5	4-5	3	4-5	4	5	4-5	5	4-5	2-3	4-5	3-4
Gold bonded	Face: Viscose & cotton Back: Nylon	3	4-5	3	3	4	3-4	3	5	5	4-5	4	3	4-5	3	4-5	4-5	4-5	4	3	4-5
Brown ground Knitted	Nylon	5	3-4	4-5	5	3	4	5	5	5	4-5	3	4	3-4	5	4-5	5	4-5	3	4	4-5
Blue Melton	Wool & other fibres	4	3	1-2	4	2-3	1	4	3	3	3-4	2-3	1-2	3	4	3-4	3-4	3-4	2-3	1-2	3-4
Blue Lining	Cellulose acetate	4	3	4-5	4-5	2-3	4	4	3-4	5	4	2	4-5	3	4	4	4-5	4-5	2-3	4	3
Red Knitted	Acrylic	5	5	5	5	5	5	5	4-5	5	5	5	5	5	5	5	5	5	5	4-5	5

TEST DETAILS:	A	B	C	D
TEMPERATURE:	50 ± 2°C	50 ± 2°C	50 ± 2°C	50 ± 2°C
TIME:	45 MINUTES	45 MINUTES	45 MINUTES	45 MINUTES
LIQUOR RATIO TO COMBINED SAMPLE:	50 : 1	50 : 1	50 : 1	-
LIQUOR VOLUME:	-	-	-	150 ml.
STAINLESS STEEL BALLS:	-	-	-	50

REFERENCE: A = Wool B = Acrylic C = Polyester D = Nylon E = Cotton F = Cellulose Acetate E.P. = Effect on Pattern

FIGURE I

COMPARABILITY TEST RESULTS EXPRESSED IN ISO GREY SCALE RATINGS

PATTERN CARD:

TEST:

- E: ISO 3 0.5% SOAP 0.2% SOD. CARB. SOL.
- F: ISO 3 4gl WOB DETERGENT 1gl SODIUM PERBORATE
- G: AS F
- H: ISO/TC/38/SC1 (UK SEC.102) 587 GB 4 gl WOB 1 gl SODIUM PERBORATE
- I: AS H

ADJACENT FABRIC: FABRIC	COMPOSITION	E: E.P.	E: NYLON 6	E: COTTON	F: E.P.	F: NYLON 6	F: COTTON	G: E.P.	G: MULTIFIBRE STRIP A	B	C	D	E	F
Red based Print	Polyester Viscose	5	4	5	5	4-5	5	5	5	5	5	5	5	5
Brown Knitted	Polyester	5	4-5	5	5	4	5	5	4-5	5	4-5	4	5	4
Blue Knitted	Polyester	5	4	5	5	5	5	5	5	5	5	4-5	4-5	5
Plum Cord	Cotton	5	3	4	5	3	4	5	4	4-5	4	3	4	3-4
Red knitted	Nylon	5	4-5	3-4	5	3-4	3	5	4-5	4-5	4	3-4	2-3	4
Raised Khaki	Cotton	3-4	5	5	4	5	5	4	5	5	5	5	5	5
Black brushed Denim	Cotton	4-5	4	4	4-5	3-4	4	4-5	4-5	4-5	4	2-3	3-4	3
Red knitted	Acrylic	5	4	4-5	5	3-4	4-5	5	4-5	4-5	4	3-4	4-5	4

FABRIC	COMPOSITION	H: E.P.	H: MULTIFIBRE STRIP A	B	C	D	E	F	I: E.P.	I: MULTIFIBRE STRIP A	B	C	D	E	F
Red based Print	Polyester Viscose	5	5	5	4-5	4	4-5	5	5	5	5	5	4-5	4-5	5
Brown Knitted	Polyester	5	4-5	5	4-5	3-4	4-5	3-4	5	4-5	5	4-5	4	4-5	4
Blue Knitted	Polyester	5	5	5	4-5	3-4	4-5	4-5	5	5	5	5	5	5	5
Plum Cord	Cotton	5	3-4	4	3-4	2-3	3-4	3	5	3-4	4-5	4	2-3	3-4	3-4
Red knitted	Nylon	5	4	4-5	4	3	2-3	4	5	4	4-5	4	3-4	3	4-5
Raised Khaki	Cotton	4	5	5	5	4-5	5	5	4	4-5	5	5	5	4-5	5
Black brushed Denim	Cotton	4-5	4	4	3-4	2-3	3	3	4-5	4	4	4	3	3-4	3
Red knitted	Acrylic	5	4	5	4	3	4	3	5	4-5	5	4	3-4	4	4

TEST DETAILS:

	E	F	G	H	I
TEMPERATURE:	60 ± 2 °C	60 ± 2°C	60 ± 2°C	60 ± 2°C	60 ± 2°C
TIME:	30 MINUTES	30 MINUTES	30 MINUTES	45 MINUTES	45 MINUTES
LIQUOR RATIO TO COMBINED SAMPLE:	50 : 1	50 : 1	50 : 1	-	-
LIQUOR VOLUME:	-	-	-	50 ml.	150 ml.
STAINLESS STEEL BALLS:	-	-	-	50	50

REFERENCE: A = Wool B = Acrylic C = Polyester D = Nylon E = Cotton F = Cellulose Acetate E.P. = Effect on Pattern

COMPARATIVE TEST RESULTS EXPRESSED IN ISO GREY SCALE RATINGS

PATTERN CARD:	J			K			L							M							N						
TEST:	ISO 4 0.5% SOAP 0.2% SOD. CARB. SOL.			ISO 4 4gl WOB DETERGENT 1gl SODIUM PERBORATE			AS K							ISO/TC/38/SC1 (UK SEC.102) 587 4B 4 gl WOB 1 gl SODIUM PERBORATE							ISO/TC/38/SC1 (UK SEC.102) 587 5B → AS K						
ADJACENT FABRIC:		NYLON 6	COTTON		NYLON 6	COTTON		MULTIFIBRE STRIP							MULTIFIBRE STRIP							MULTIFIBRE STRIP					
FABRIC COMPOSITION	E.P.			E.P.			E.P.	A	B	C	D	E	F	E.P.	A	B	C	D	E	F	E.P.	A	B	C	D	E	F
Blue Denim Cotton	2	3–4	2–3	1–2	3–4	2–3	1–2	4–5	5	5	3–4	2–3	5	1–2	4–5	5	4–5	3–4	2	5	1–2	4	5	4	3	1–2	5

TEST DETAILS:

	J	K	L	M	N
TEMPERATURE:	95 ± 2°C	95 ± 2°C	95 ± 2°C	70 ± 2°C	95 ± 2°C
TIME:	30 MINUTES	30 MINUTES	30 MINUTES	45 MINUTES	45 MINUTES
LIQUOR RATIO TO COMBINED SAMPLE:	50 : 1	50 : 1	50 : 1	-	-
LIQUOR VOLUME:	-	-	-	50 ml.	50 ml.
STAINLESS STEEL BALLS:	10	10	10	100	100

REFERENCE: A = Wool B = Acrylic C = Polyester D = Nylon E = Cotton F = Cellulose Acetate E.P. = Effect on Pattern

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