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METHODS OF TEST FOR

KNITTED FABRIC CONSTRUCTION

SRI LANKA STANDARDS INSTITUTION

METHODS OF TEST FOR KNITTED FABRIC CONSTRUCTION

SLS 774:1987

Gr. 11

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SRI LANKA STANDARD

METHODS OF TEST FOR KNITTED FABRIC CONSTRUCTION

FOREWORD

This Sri Lanka Standard was authorized for adoption and publication by the Council of the Sri Lanka Standards Institution on 1987-01-07, after the draft, finalized by the Drafting Committee on Test Methods for Textiles, had been approved by the Textiles Divisional Committee.

All values given in this standard are in SI units.

In the preparation of this standard the valuable assistance derived from the publications of the Textile Institute and the British Standards Institution is gratefully acknowledged.

1 SCOPE

This standard prescribes methods of test for wrap knitted and weft knitted fabric construction.

2 REFERENCES

CS 16 Standard atmospheres for conditioning and testing textiles

CS 17 Determination of moisture in textile materials and of correct invoice weight

SLS 25 Removal of non-fibrous matter prior to qualitative analysis of fibre mixtures (Second revision).

3 DEFINITIONS

For the purpose of this standard the following definitions shall apply:

3.1 accordion fabric : A weft-knitted fabric showing a figure design in two or more colours, which is produced on one set of needles by knitting, tucking and missing, and in which tuck loops are introduced to eliminate long lengths of floating thread at the back.

3.2 circular machine : A knitting machine having the needles carried in a circular bed (or beds).

3.3 closed loop (wrap knitting) : A loop in which the same thread crosses over itself at the base of the loop.

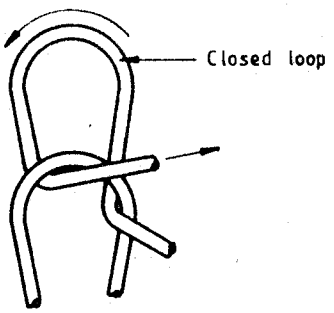


FIGURE 1 - Closed loop

3.4 course : A row of loops across the width of the fabric.

3.5 double-jersey fabric : A fabric produced on two sets of needles, usually based on rib or interlock structures, in a manner that reduces the natural extensibility of the knitted structure.

3.6 flat machine : A weft knitting machine having straight needle beds carrying independently operated latch needles.

3.7 guide bars : Bars running the full width of the machine and equipped with guides through which threads may be passed so that lateral motions imparted to the guide bars by cam, jacquard or other pattern-control device are transmitted to the threads.

3.8 intarsia : Weft-knitted plain, rib or purl fabrics containing designs in two or more colours. Each area of colour is knitted from a separate yarn, which is contained entirely within that area.

3.9 missed loop (weft knitting) : A length (or lengths) of yarn not received by a needle and connecting two loops of the same course that are not in adjacent wales.

3.10 open loop (warp knitting) : A loop in which the same thread enters and leaves the loop at opposite sides without crossing over itself.

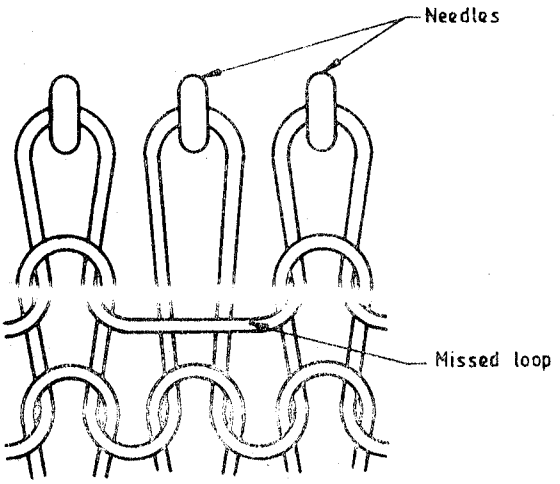


FIGURE 2 - Missed loop (shown from back of fabric)

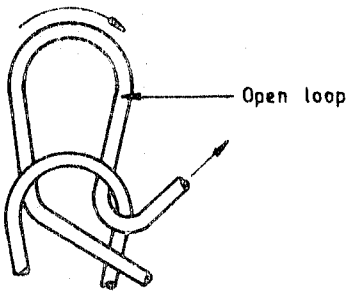


FIGURE 3 - Open loop

3.11 overlap (warp knitting) : Lateral movement of the guide bars on the beard or hook side of the needles.

3.12 plain knitted fabric : A weft-knitted fabric in which all the loops are intermeshed in one direction.

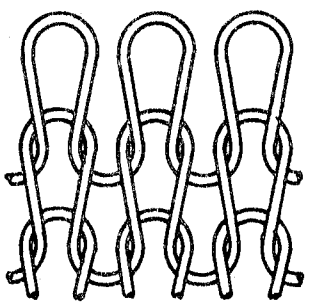


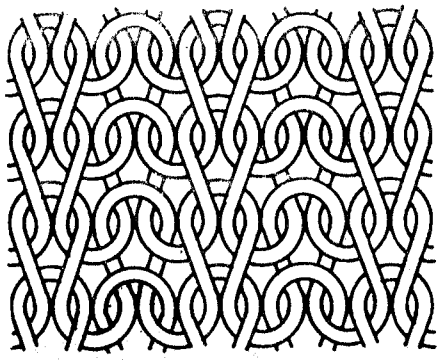
FIGURE 4 - Plain knitted structure

3.13 raschel fabric (warp knitting) : A fabric made on a raschel machine.

3.14 reverse-plated fabrics (weft knitting) : Plain fabrics produced by a reversal of the yarn positions within certain stitches so that the opposite yarn appears on the face of the fabric.

3.15 rib knitting : A system of knitting in which all the loops of some wales are intermeshed in one direction and all those of the other wales knitted at the same course are intermeshed in the opposite direction.

3.16 1 x 1 rib : A fabric in which all the loops of alternate wales are intermeshed in one direction and all the loops of the other wales knitted at the same course are intermeshed in the other direction.



Repeat

FIGURE 5 - 1 x 1 rib structure

3.17 transferred loop : A loop transferred from one needle to another.

3.18 tuck loop : A length(s) of yarn received by a needle and not pulled through the loop of the previous course.

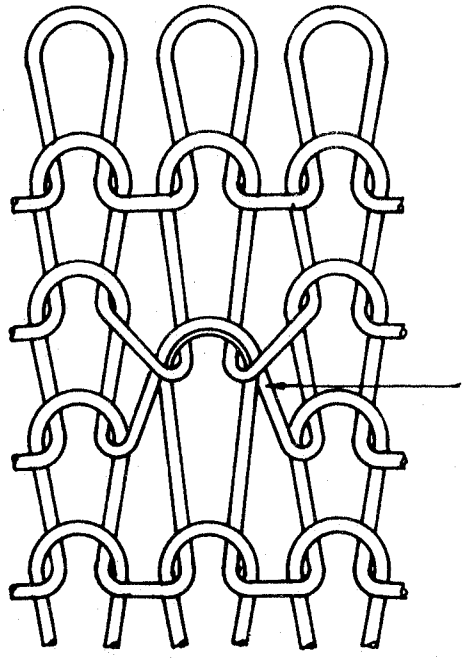


FIGURE 6 - Tuck loop (shown from back of fabric)

3.19 underlap (warp knitting) : (1) Lateral movements of the guide bars made on the side of the needle remote from the hook or beard; (2) In the fabric, the connection between stitches in consecutive courses in a warp-knitted fabric.

3.20 wale : A column of loops along the length of the fabric.

4 APPARATUS

4.1 *Counting glass,* the aperture width of which shall be 2 ± 0.005 cm at all places. The thickness of the base plate at the edges of the aperture shall not exceed 0.1 cm. Other suitable apparatus may be used.

4.2 *Ruler*

4.3 *Dissecting needles, scissors and razor blades*

4.4 *Balance,* capable of weighing to an accurancy of 0.1 mg.

4.5 *Crimp tester*

4.6 *Course length tester,* consisting of a weighted clamp and a rigid base-board adapted for mounting vertically on which are mounted an appropriate number of freely rotating pulleys so positioned that the yarn can be wound round them in a zig-zag manner, and a series of locations for a yarn clamp labelled to show the distance from the clamp to the zero point of a metric ruler. When the yarn is attached to the clamp and wound round the pulleys, the length indicated on the ruler by the weighted clamp is added to that indicated on the appropriate location is use to give the total length of yarn.

5 ATMOSPHERE FOR CONDITIONING AND TESTING

The conditioning and testing atmosphere shall be the standard atmosphere for conditioning and testing textiles as defined in **CS 16,** i.e. a relative humidity of 65 ± 2 per cent and a temperature of 27 ± 2 ^{o}C.

SECTION ONE - WEFT KNITTED FABRICS

6 DETERMINATION OF WEFT KNITTED FABRIC STRUCTURE

6.1 Principle

The path of individual threads is determined during a complete repeat of the pattern.

6.2 Test specimen

The test specimen shall be of sufficient size to enable the complete pattern to be analysed.

6.3 Notation

The notation of weft knitted fabric presents difficulties in the sense that no one notation system is convenient for representing all of the weft knitted structures possible.

Three systems, described in 6.3.1, to 6.3.3, are particularly useful in connection with fabric analysis.

6.3.1 *Thread path diagrams*

The system of thread path diagrams uses point paper printed with suitably spaced small dots. The diagrams are suitable for recording plain and rib-based fabrics containing tuck and/or missed loops. The system is machine related, in that each dot represents the site of a loop-producing element. The dots are arranged in parallel rows corresponding to the disposition of the loop-producing elements in rib machines. (Different arrangements are required for rib-gaited rib machines and interlock-gaited rib machines). The latter arrangement may also be used to represent purl fabrics. The parallel rows of dots are arranged in pairs, one pair representing a course-producing cycle. The top row of dots of a pair represent the loop-producing elements of the rear bed of a flat machine, or the dial or upper cylinder of a circular machine.

When producing plain-based fabrics only one of the rows of dots is used.

A diagram of each successive course is made as it is unroved during the analysis, using the symbols shown in the examples (see Figs. 7 and 8).

It is sometimes difficult to comprehend the whole of the structural repeat of a fabric when looking at the course by course breakdown. It is to be expected that the information in such instances is transferred to graph paper using either the *Prusa* or the squared-paper systems.

6.3.2 *The "Prusa" system*

The *Prusa* system uses specially ruled graph paper and is particularly useful for portraying fabrics containing transferred or displaced loops. The paper (see Fig. 9) contains alternately thick and thin vertical lines denoting the sites of face and back wales of a basic 1 x 1 rib structure (it is still possible to protray plain fabric or any rib other than 1 x 1 on this paper). Horizontal lines divide the paper between courses. Purl fabrics cannot be portrayed by this system, which is also inappropriate either for knit and miss structures or for large scale knit and tuck structures. There are not distinguishing marks between open and closed loops.

6.3.3 *The squared-paper system*

The squared-paper system uses graph paper ruled with 2 mm squares. Each square represents a loop or the site of a loop. A horizontal row of squares represents a knitted course or a design course. A vertical row of squares represents a wale. If possible, the most frequently occurring unit should be represented by a blank square, appropriate symbols of choice for the other units being used. A key relating the types of loop to the particular symbol shall always be given. Examples are shown in Figure 10.

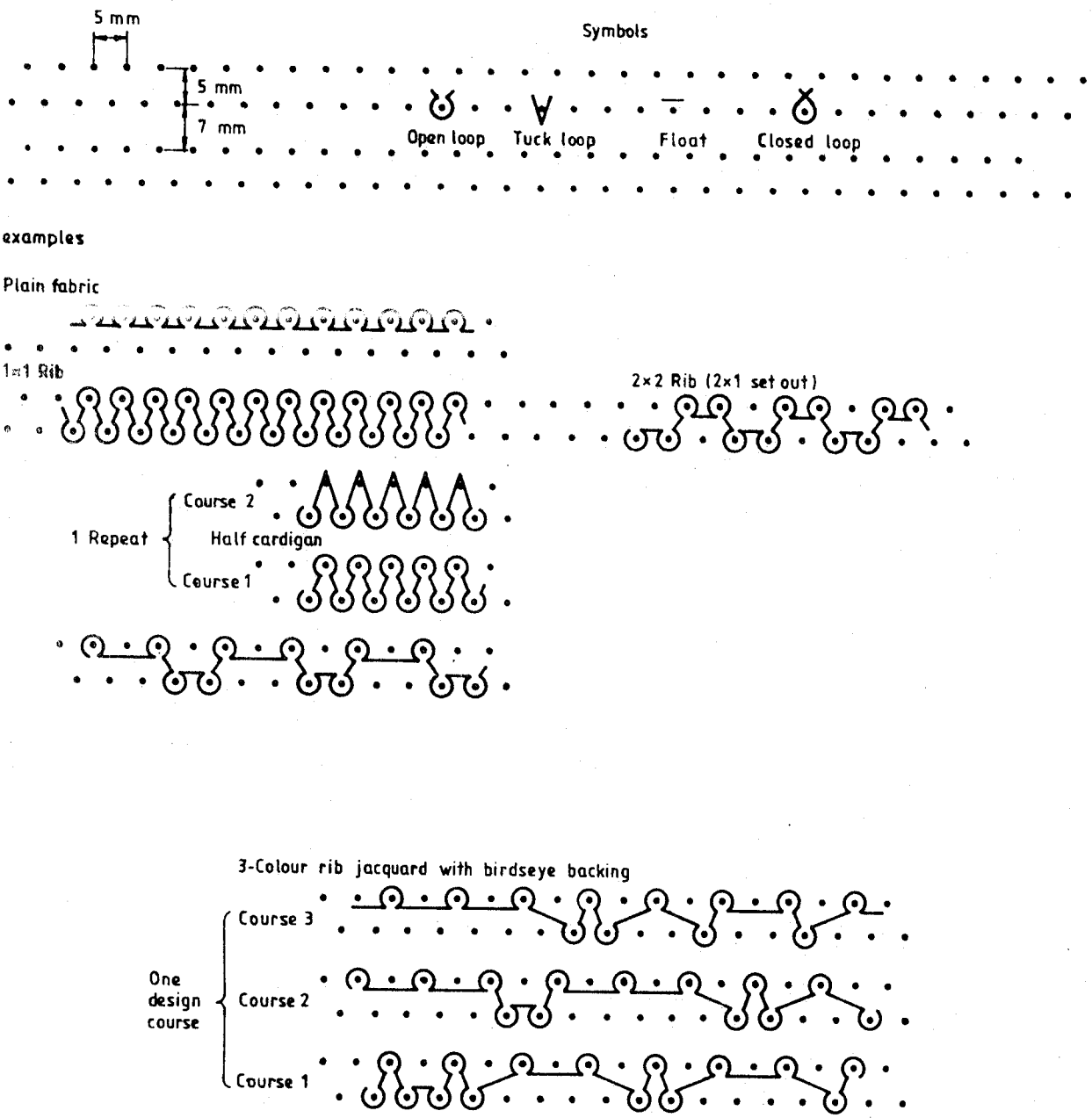


FIGURE 7 - Rib-gaited thread path diagram system
(See 6.3.1 and 6.5)

The system may be used to portray fabric of plain, rib or purl basic structure, containing most types of loop modification. It is particularly useful for fabrics containing tuck loops, miss loops and plush loops. It is also used to portray, in abbreviated form, colour jacquard fabric including intarsia, single 2, 3 and 4 colour jacquard and accordion fabrics, reverse-plated fabrics, and 2, 3 and 4 colour rib jacquard, as well as relief or blister fabrics. In all of these the symbols in the squares denote only the colour of the particular knitted loop appearing on the effect side of the fabric.

The system is not capable of portraying other than the most simple of loop transfer fabrics and cannot represent racked-rib fabrics.

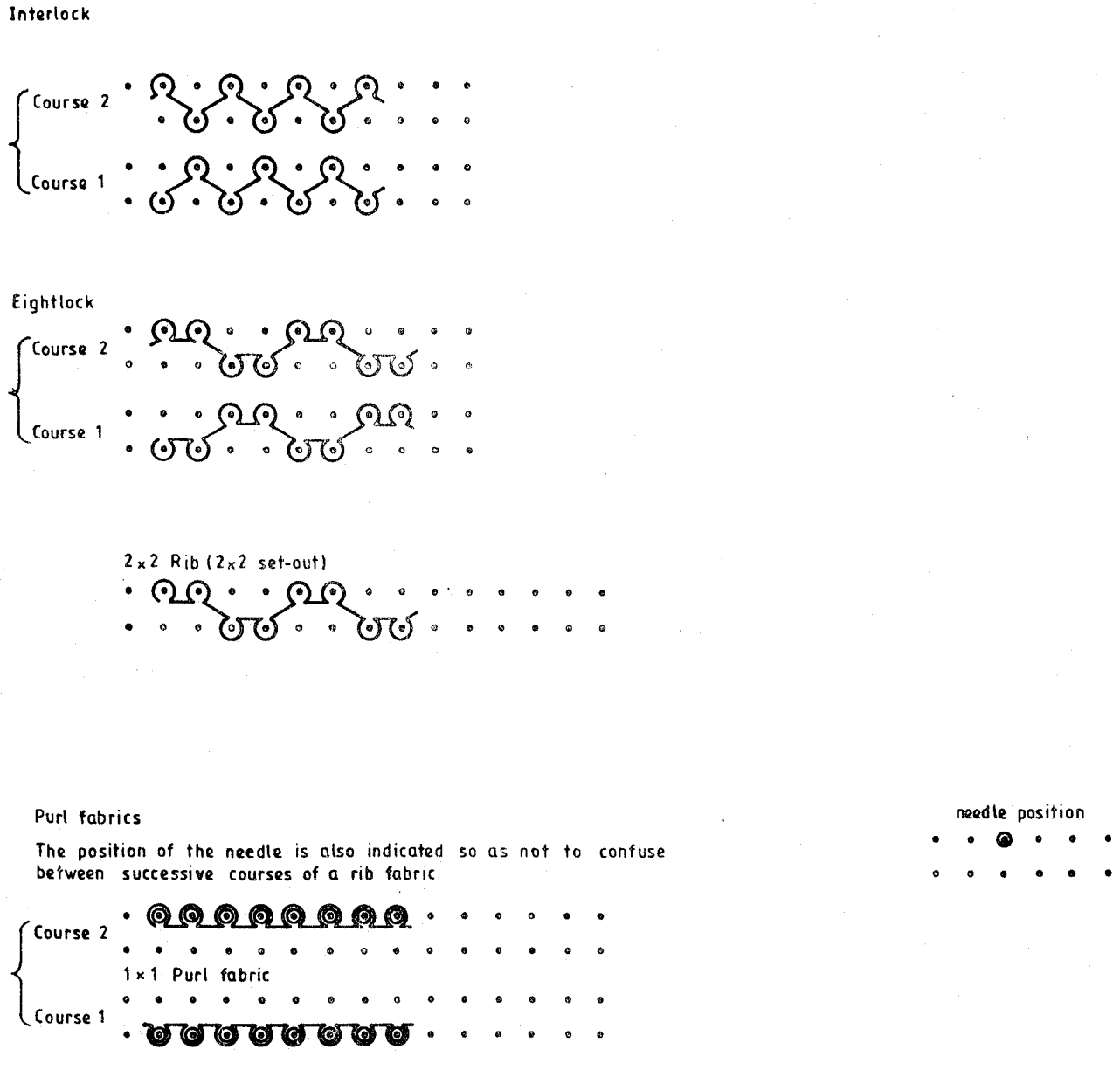


FIGURE 8 - Interlock-gaited thread path diagram system
(See 6.3.1 and 6.5)

6.4 Procedure

Using the appropriate system from 6.3, note the fabric construction. The path of particular yarns in the structure may be more easily followed if they are stained, or lifted by the dissecting needle, or if the other yarns are cut away.

6.5 Test report

The test report shall include the fabric construction by the system chosen.

NOTE - Where symbols are used, ensure that their meaning is adequately explained in a key. Examples of the methods of notation are given in Figures 7 to 11.

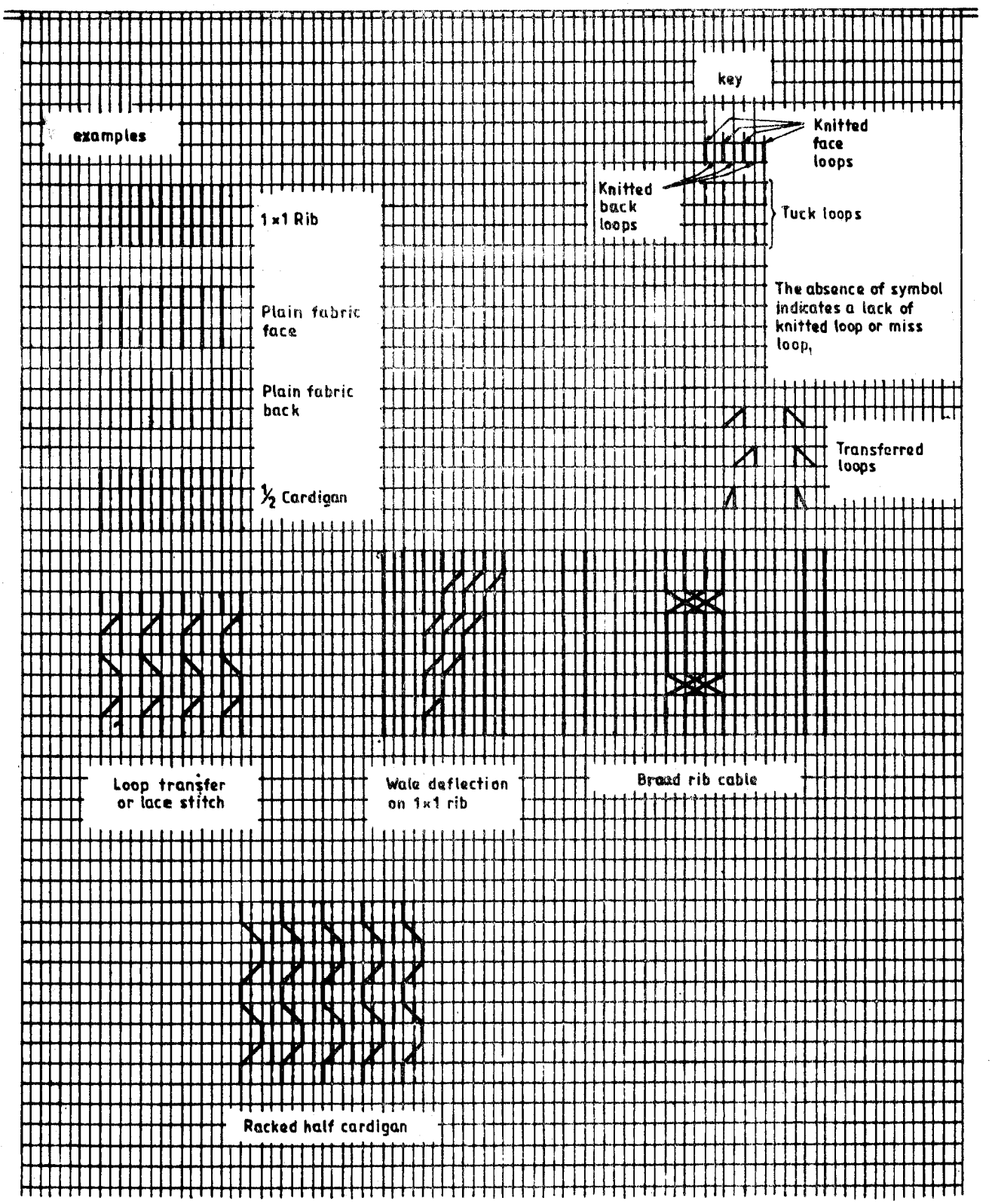


FIGURE 9 - 'Prusa' system
(See 6.3.2 and 6.5)

examples

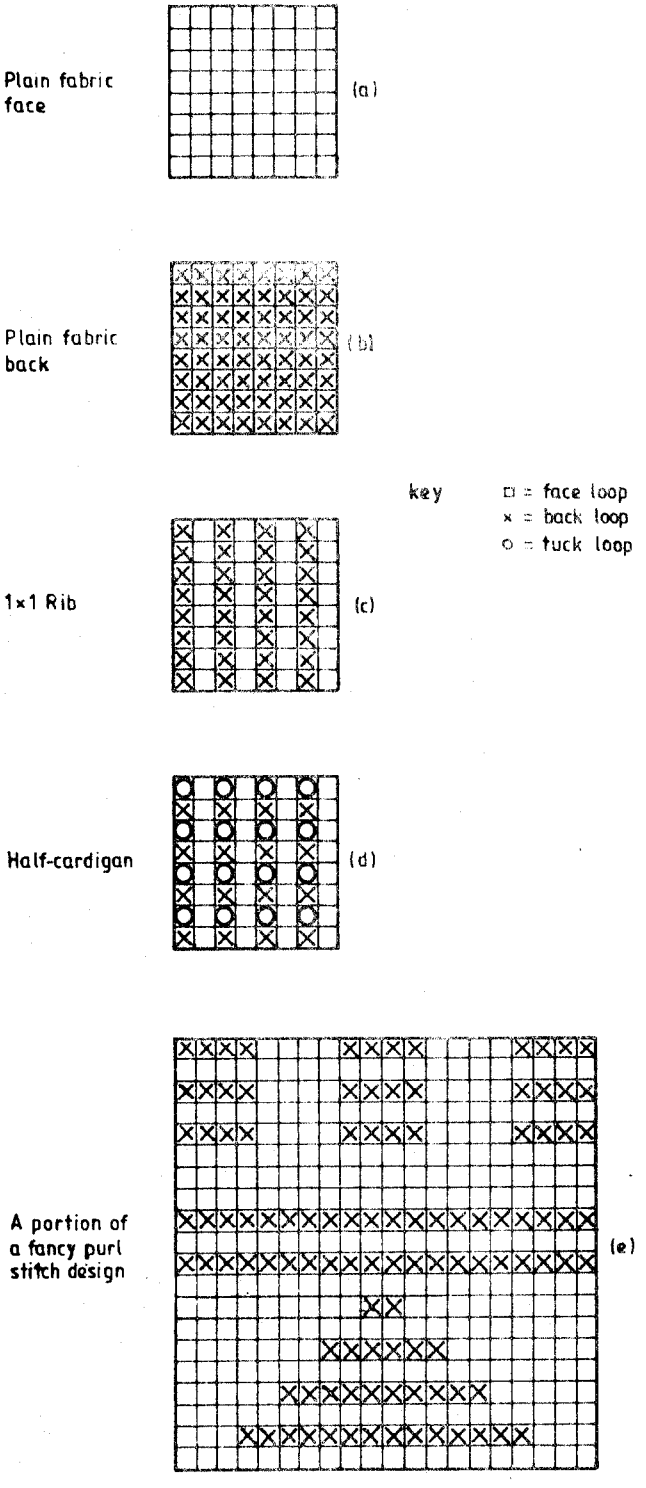


FIGURE 10 - Squared-paper system (1)
(See 6.3.3 and 6.5)

3 - Colour rib jacquard,with birdseye backing

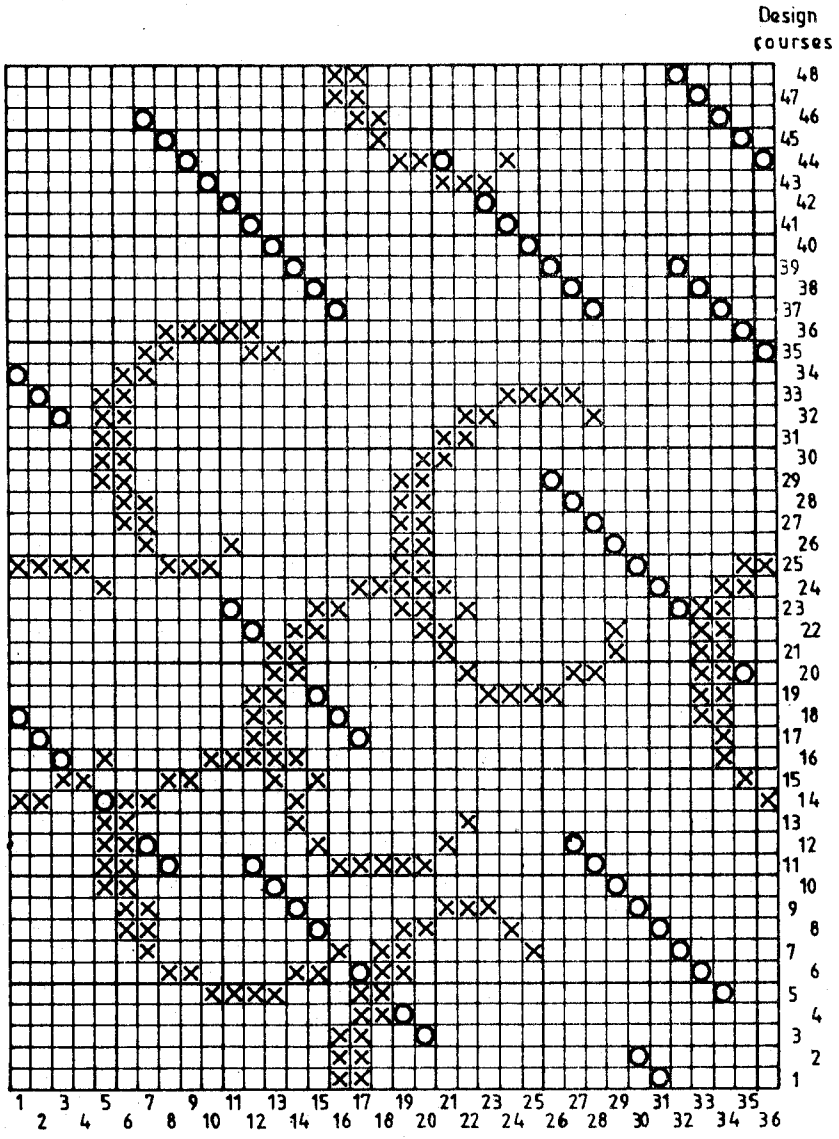


FIGURE 11 - Squared-paper system (2)
(See 6.5)

7 DETERMINATION OF THE NUMBER OF VISIBLE WALES AND COURSES PER CENTIMETRE

7.1 Principle

The number of face wales and courses visible within a minimum measuring distance are counted. The result is expressed as wales or courses per centimetre.

7.2 Minimum measuring distance

The minimum measuring distance over which the number of wales or courses shall be measured shall be as detailed in Table 1.

TABLE 1 - Minimum measuring distance

Visible wales or courses per cm (1)	Minimum measuring, cm (2)	Accuracy of an individual measurement in wales or courses per cm (3)
less than 10	10	0.1
10 to 50	5	0.2
more than 50	2	0.5

7.3 Test specimen

The test specimen shall be sufficiently large to enable the wales and courses to be counted at five different places, over the minimum measuring distance as specified in **7.2**, selected to represent the fabric as fully as possible.

7.4 Procedure

7.4.1 Condition the test specimen in the standard atmosphere for conditioning and testing (see **5**) for a minimum of 16 h before the test.

7.4.2 Lay the specimen face upwards on a horizontal surface, and apply the minimum tension required to keep the fabric flat. Using a counting glass **(4.1)** or ruler **(4.2)** and/or low-power microscope, as appropriate, count the number of wales over the minimum measuring distance specified in **7.2.** Repeat this for the courses in the fabric.

7.4.3 Repeat this procedure at five different places on the specimen.

7.5 Calculation and expression of results

Number of wales or courses, per centimetre $= \frac{N}{L}$

where,

N = number of wales or courses counted over the specified measuring distance; and

L = measuring distance, in centimetres.

NOTE - In complex structures the wales and courses recognised on visual inspection of the fabric may be made up of two or more structural wales or courses. In such cases this will be apparent from the analysis of fabric construction by dissection specified in **6**. *The figures for visible wales and courses per unit length may be multiplied by the appropriate integers determined from the number of needles and courses in one repeat cycle. The values so obtained may be referred to as structural wales and courses per centimetre.*

7.6 Test report

The test report shall include the following particulars.

a) measuring distance used; and

b) mean value of the five results.

8 DETERMINATION OF COURSE LENGTH

8.1 Principle

The fabric to be examined is prepared in such a manner that lengths of yarn forming complete knitted courses can be unroved. The lengths of yarn are measured in a straightened state under suitable tension. The straightened state is achieved by removing the knitting crimp and/or yarn or filament crimp as found in textured filament yarns.

8.2 Test specimen

The test specimen shall be sufficiently large to enable lengths of yarn forming complete knitted courses to be unroved.

If the fabric is in tubular form, make a short cut with a pair of scissors(4.3) down a wale line.

If the fabric is in open width or flat form, carefully cut the edges of the fabric.

8.3 Procedure

8.3.1 Determine the direction from which the fabric unroves and commence unroving until a complete course can be extracted.

8.3.2 If the course length is short for example less than 1 m, determine the length by means of a crimp tester, as described in 9.

8.3.3 If the course length is large, use a course length tester (4.6).

8.3.3.1 Fasten the clamp into the appropriate metal plate on the base board (this can rapidly be found by trial and error) and ensure that the pulleys are free to rotate.

8.3.3.2 Attach one end of the yarn to the clamp and unrove the remainder of the yarn over the pulleys in the direction indicated. In some cases, especially where it is difficult to unrove the yarn, it is permissible to unrove the yarn from the fabric before mounting it on the tester, but, in this case, care shall be taken to avoid loss of yarn twist.

8.3.3.3 Fasten the weighted clamp to the end of the yarn that hangs over the metre rule. Note the reading on the metre rule and add this to the figure inscribed on the label at the position of the other clamp. This gives the total course length.

NOTE - The mass attached to the unroved yarn shall be sufficient to straighten it. For staple yarns use masses giving a tension of approximately 1.5 mN/tex.

For most textured continuous filament yarns upto 300 dtex, use masses giving a tension of approximately 20 mN/*tex.*

8.3.4 Measure at least 12 course lengths. Where a multifeed machine is known to have been used, and if it is suspected that there is a variation in course length, take at least one course length from each feeder. If more are taken, ensure that the number is a multiple of the number of feeders on the machine.

8.4 Test report

In the case of fabrics that have substantially the same course length for each course, report both the individual results and the arithmetic means of the course length in millimetres.

In the case of fabrics that, owing to their construction, have considerably different course lengths, for example double jersey fabrics and patterned fabrics, group the course lengths and calculate the arithmetic mean for each group. Report both the individual and mean results of the course length in millimetres.

9 DETERMINATION OF STITCH LENGTH

9.1 Uncut fabrics

9.1.1 *Principle*

The course length is determined and the stitch length is obtained by calculation from the number of needles used in the production of a fabric.

9.1.2 *Procedure*

Measure the course length as described in 8. Determine the number of needles used in the production of the fabric by counting the number of available needle positions.

9.1.3 *Calculation and expression of results*

$$\text{Stitch length} = \frac{L_c}{N}$$

where,

L_c = course length, in millimetres; and

N = number of needles used in the production of the fabric.

9.2 Cut samples

9.2.1 *Principle*

If uncut fabric is not available, a length of yarn is taken from the sample and measured and the number of needles used to produce the length is determined. Stitch length is obtianed by calculation.

9.2.2 *Test specimen*

The test specimen shall be either 25 cm wide or large enough to enable 100 stitches to be cut from one course.

9.2.3 *Procedure*

9.2.3.1 Condition the sample for 16 h in the standard atmosphere for conditioning and testing (see 5).

9.2.3.2 Cut along one wale of the sample to be tested. Count 100 stitches starting from this cut and again cut along a wale. Alternatively make a second cut 25 cm from the first and count the number of needles used over this distance.

9.2.3.3 Remove a length of yarn from the cut portion and attach it to the clamps of a crimp tester (4.5). Set the tension device attached to one of the the yarn grips to one of the levels given in Table 2.

TABLE 2 - Tensions

Type of yarn	Linear density	Tension
Spun yarns	over 100 tex	150 mN
	30 tex to 100 tex	100 mN
	0 to 30 tex	50 mN
Filament yarns	all	20 mN/tex

Measure the length of straightened yarn in millimetres and repeat the above procedure for 12 different lengths of yarn. Where a multifeed machine is known to have been used, and it is suspected that there is a variation in stitch length, take at least one length of yarn from each feeder. If more are taken, ensure that the number is a multiple of the number of feeders on the machine.

9.2.4 *Calculation and expression of results*

Calculate the stitch length in millimetres (see 9.1.3) and also the arithmetic mean of the individual results.

9.3 Test report

The test report shall include the following particulars:

a) individual results

b) mean value.

10 DETERMINATION OF LINEAR DENSITY OF COMPONENT YARNS

10.1 Principle

Lengths of yarns are removed from the fabric and their mass is determined. The linear density in a unit of the Tex System is then calculated.

10.2 Test specimen

Use the same test specimen as described in **8.2** for course length or **9.2.2** for stitch length.

10.3 Procedure

10.3.1 Determine the straightened length of 12 lengths of yarn, as described in **8.3** or **9.2.3**, and then remove at least 38 more lengths of yarn.

10.3.2 Remove any added matter using the recommended procedure for removal of added matter from textiles as given in **CS 25**.

10.3.3 Dry the lengths of yarn at 108 ± 2 °C to constant mass (to an accuracy of 0.5 per cent). Determine the mass of the 50 lengths of yarn to an accuracy of 0.5 per cent and add the recommended allowance given in **CS 17**.

10.4 Calculation and expression of results

Calculate the linear density in a unit of Tex System from the total calculated length and total mass of the 50 lengths of yarn.

10.5 Test report

Report the linear density of the component yarns in a unit of the Tex System.

SECTION TWO - WARP KNITTED FABRICS

11 DETERMINATION OF WARP KNITTED FABRIC STRUCTURE

11.1 Principle

The path of one representative thread from each guide bar is determined during a complete repeat of the pattern and this is supplemented by the threading arrangement of the guide bar.

Warp knitted fabric can be made with one or two sets of needles. In the latter case the fabric is either tubular or has loops on both faces, as with double-jersey weft knitted fabric. The procedures given here refer only to fabrics produced on one set of needles, but may be applied with caution to circular fabrics.

If a lace fabric is under examination, and has been produced on a hexagonal or square background, it may be preferable to use paper with spaces of the same shape as the ground. The method specified here would not necessarily be applicable to lace fabrics, and similar considerations apply to embroidered patterns.

11.2 Test specimen

The test specimen shall be of sufficient size to enable the complete pattern to be analysed.

11.3 Notation

11.3.1 *Guide bar motions*

Plot the thread path on point paper. Each point represents a needle in the machine. A vertical column of points represents a wale and a horizontal row represents a course.

Number the spaces between the points from right to left starting with zero, and numbering subsequent spaces with successive integers unless the fabric is obviously a raschel fabric, in which case they may be numbered with the even integers.

An overlap is indicated by an arc of a circle above a dot and the underlap of a knitting thread connects two consecutive arcs or overlaps. The underlap of a non-knitting thread connects needle spaces.

11.3.2 *Guide bar threading*

Represent the threading of a partly threaded guide bar by the symbol/ for a threaded guide and a full stop(.) for an empty guide. When different types of yarn are used in the same guide bar, give them in sequence for a pattern-repeat, moving from left to right viewing the fabric from the technical back. Position the threading schemes for the various bars under one another so that they represent the state of the machine at a particular point of the pattern. This point shall be specified in terms of the notation or of the pattern chain links if these are known.

11.4 Procedure

11.4.1 The path of particular yarns in the structure may be more easily followed if they are stained, or lifted by the dissecting needle, or if the other yarns are cut away.

11.4.2 Start the analysis by determining which yarns are nearest to the surface on both sides of the fabric, but particularly on the technical back. These will usually be from the front guide bar while threads from the other guide bars will usually be in sequence, with back guide bar threads at the centre of the structure.

11.4.3 Complete the notation for the front guide bar threads before analysing the next set and continue in this fashion until the last set of threads is examined. The total number of guide bars used in the structure will then be known.

11.4.4 Commence the notation of the guide bar motions at the same course on the technical back for each guide bar in turn. Threads from the same guide bar normally follow identical or parallel parts through the structure, and as guides are usually of the same gauge as the needles, a full threaded guide bar will provide one thread for each wale. Partly threaded guide bars are often recognized by open work and corded construction.

11.5 Test report

Record the results under the heading of thread path, notation and guide bar threading for all the guide bars. Examples of typical notations are given in Figure 12.

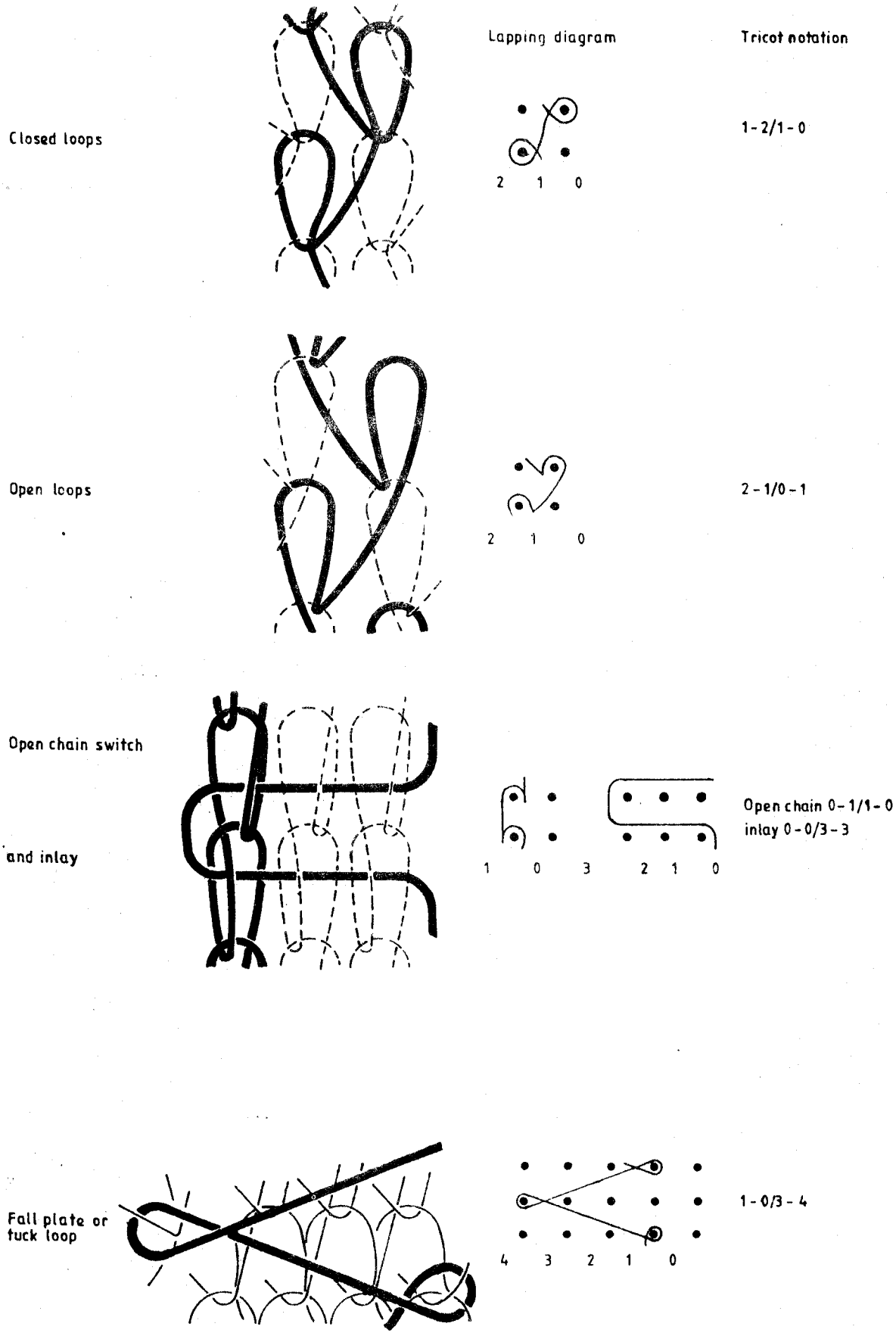


FIGURE 12 - Symbols for thread path diagrams in warp knitted fabrics
(See 11.5)

12 DETERMINATION OF THE NUMBER OF VISIBLE WALES AND COURSES PER CENTIMETRE

Determine the numbers of wales per centimetre and courses per centimetre using the method specified in **7**. If the fabric contains tuck loops (mis-pressing) or knitted-in pleats, report this fact and take account of them in the number of courses in the measured length. Do not count closed fall plate loops unless they are unsupported by normal knitted loops.

13 ESTIMATION OF RUN-IN

13.1 General

Many warp knitted fabrics cannot be dissected since they are either too complex or partially destroyed by finishing. In these cases it will not be possible to determine run-in or linear density of the yarn and these values can only be estimated.

13.2 Principle

A length of yarn is removed from a fixed number of courses from each guide bar, straightened in a crimp tester and its length measured.

The length corresponding to one rack (i.e. 480 courses) is then calculated.

13.3 Test specimen

The test specimen shall contain a sufficient number of courses (see **13.4**) and shall contain at least the number of wales corresponding to the guide bar with the longest underlap.

13.4 Procedure

Decide on the number of courses to be examined. This number should be a factor of 480, but shall be at least 20.

13.4.1 *Unroving procedure*

Slightly stretch the fabric and pin it down on a board. Trim the top edge along one course. Count down the number of courses to be unroved from the top edge and mark the final course with ink or a pen.

Using a counting glass **(4.1)** and two dissecting needles **(4.3)**, unrove the loops course by course by pulling at the underlap and thus drawing out the previous overlap. The number of wales unroved shall be at least the number of needles traversed by the guide bar with the longest overlap.

When marked course is reached, cut out the yarn and measure its length using a crimp tester **(4.5)**, as described in **9**.

13.4.2 *Cutting procedure*

Using a razor blade or fine scissors **(4.3)** cut a strip of the fabric one or two wales wide, corresponding to the smallest underlap, in effect cutting out one warp thread. Measure its length using a crimp tester, as described in **9**.

In some cases, it may be possible to remove the second smallest underlap. Thread a long needle between the loops so as to protect the thread of the second smallest underlap. Then shave off the loops on the opposite side of the needle, taking care not to damage the thread that is being removed. Measure its length using a crimp tester, as described in **9**.

13.5 Test report

Report the results for each guide bar in millimetres per rack. This gives the run-in in the finished state and may be less than the original run-in.

14 DETERMINATION OF LINEAR DENSITY OF COMPONENT YARNS

Using the lengths of yarn obtained by the method specified in **13**, determine their linear density in accordance with **10**.

SRI LANKA STANDARDS INSTITUTION

The Sri Lanka Standards Institution (SLSI) is the national standard organization of Sri Lanka established by the Sri Lanka Standards Institution Act No. 6 of 1984 which repeals the Bureau of Ceylon Standards Act No. 38 of 1964. The Institution functions under the Ministry of Industries and Scientific Affairs.

The principal objects of the Institution as set out in the Act are to prepare standards and promote their adoption, to provide facilities for examination and testing of products, to operate a Certification Marks Scheme, to certify the quality of products meant for local consumption or exports and to promote standardization and quality control by educational, consultancy and research activity.

The Institution is financed by Government grants, and by the income from the sale of its publications and from other services. Financial and administrative control is vested in a Council appointed in accordance with the provisions of the Act.

The detailed preparation of standard specifications is done by Drafting Committees composed of experts in each particular field assisted by permanent officers of the Institution. These Committees are appointed by the Divisional Committees, which in turn are appointed by the Council. All members of the Drafting and Divisional Committees render their services in an honorary capacity. In preparing the standard specifications, the Institution endeavours to ensure adequate representation of all view points.

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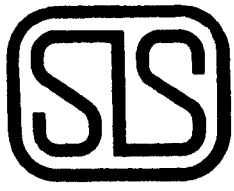

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