



British Standard Aerospace Series : Procedure for

Inspection and testing of textiles

Série aérospatiale : Procédure de contrôle et d'essai des textiles

Luft- und Raumfahrtreihe : Verfahren zur Überwachung und Prüfung von Textilien

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Compliance with a British Standard does not of itself confer immunity from legal obligations.

Foreword

This British Standard covers the general inspection and testing requirements and certain basic quality requirements for textiles for aerospace purposes. Details of the classification, methods of marking and acceptance limits for the more common defects in certain broad groups of textiles are given in appendix A. The requirements specified herein are for use in conjunction with the relevant specifications in the 'F' series and are also applicable to other specifications for textiles for aerospace purposes, where appropriate, such as those in the Ministry of Defence (Procurement Executive) D.T.D. Series.

The first edition of this British Standard was published in August 1957 and the second and third editions in September 1966 and February 1975 respectively. This fourth edition brings procedures into line with current practices in the United Kingdom and, where applicable, international agreements.

The principal changes are the inclusion of inspection requirements, method of test and acceptance limits for defects in knitted fabrics. In addition, appendix B details criteria to minimize the degradation of textiles by marking media. The opportunity has also been taken to revise the standard, where appropriate, in keeping with the changes resulting from the revision of other British Standards.

With regard to flammability testing, the horizontal test method and one of the vertical strip test methods have been deleted to standardize on the vertical test method used by the Civil Aviation Authority.

WARNING NOTE. Some of the reagents used in the test procedures called for in this standard may be injurious to health and it is essential that adequate precautions be taken in their use. Attention is drawn to the requirements of the Health and Safety at Work etc. Act 1974.

Section one. General

1. Scope

This British Standard specifies procedures for the inspection and testing of materials covered by specifications for textiles for aerospace purposes. Certain quality requirements relating to dimensions, freedom from defects, freedom from corrosive impurities, flammability and colour fastness are specified and permitted tolerances are stated where applicable.

This British Standard does not purport to cover all quality requirements for subsequent processing or the end use of the textile.

2. References

This standard makes reference to the following publications.

F 8	Mercerized 140 g cotton fabric and serrated edge strip
F 37	Specification for 570 g/m ² and 640 g/m ² cotton fabrics
F 57	Scoured cotton fabric for inflatable equipments
F 118	Specification for 50 g/m ² nylon parachute fabric
X 26	Doping and finishing schemes for fabric covered aircraft
BS 381C	Specification for colours for identification, coding and special purposes
BS 1006	Methods of test for the colour fastness of textiles and leather
BS 1610	Methods for the load verification of testing machines
BS 1647	pH scale
BS 2862	Method for the determination of the number of threads per centimetre in woven fabrics
BS 3266	Methods of test for the determination of conductivity, pH, water soluble matter, chloride and sulphate in aqueous extracts of textile materials
BS 3591	Industrial methylated spirits
BS 5441	Methods of test for knitted fabrics
BS 5651	Cleansing and wetting procedures for use in the assessment of the effect of cleansing and wetting on the flammability of textile fabrics and fabric assemblies

NOTE. The issue number of an Aerospace Series standard is indicated by a prefix number.

3. Definitions

For the purposes of this British Standard the following definitions apply.

3.1 textile. Any fabric (however constructed), sewing thread or cordage made from natural or man-made fibres or blends of these.

3.2 narrow fabric. A fabric constructed at 450 mm width or less.

3.3 wide fabric. A fabric constructed at more than 450 mm width.

3.4 braided cordage. Cordage of braided or plaited construction.

3.5 laid cordage. Cordage constructed by twisting three or more strands about each other to form a helix round a central axis.

3.6 rope. Cordage of diameter 4 mm or more.

3.7 cord or line. Cordage of diameter less than 4 mm.

4. Manufacturer, supplier and certification

4.1 Manufacturer and supplier. For the purposes of this British Standard the terms 'manufacturer' and 'supplier' shall have the following meanings.

(a) **Manufacturer.** The firm making the material into the form (yarn, loomstate fabric, finished fabric, etc.) in which it is consigned to the purchaser.

(b) **Supplier.** The firm consigning the material to the purchaser.

4.2 Quality Assurance Authority. The Quality Assurance Authority referred to in this standard is as stated in the contract or order, or the accredited representative of the Authority stated, as instructed by the prime contractor.

4.3 Certification

4.3.1 With each delivery of material, the manufacturer shall supply consignment documentation (e.g. certificate of conformity, declaration, etc.) containing the following minimum information and certificate.

- Consignee's name and address.
- Consignor's name and address.
- Reference number and date of document.
- Contract and/or order number.
- Description of supplies and quantity.
- The numbers of the relevant British Standards and of other relevant specifications.
- Identification marks (e.g. batch number, piece numbers, etc.).
- Reference to a test report giving the date of testing.
- Non-conformance (e.g. concessions or production permits).
- A certificate signed by a duly authorized employee of the company, in the following form unless otherwise required by the Quality Assurance Authority.
'Certified that the whole of the supplies detailed hereon have been inspected, tested and, unless otherwise stated above, conform in all respects with the requirements of the contract or order.'

4.3.2 For material consigned by a supplier other than the manufacturer, all the information required by 4.3.1, as provided by the manufacturer, shall form part of the supplier's consignment documentation.

4.3.3 If a batch of material consigned by the manufacturer is subdivided by a stockist or other non-manufacturer before reconsignment, he shall carry out any consequent additional dimensional inspection and identification marking and shall certify accordingly.

5. Sampling and testing

5.1 General. Except where otherwise specified in the appropriate textile specification, testing to the requirements specified for the textile in the condition as sampled shall be carried out in accordance with this standard on properly identified samples taken as directed in 5.2, 5.3 and 5.4, as appropriate.

5.2 Special sampling frequency. For new production (i.e. with a manufacturer working for the first time on a particular type of textile), the frequency of sampling shall be increased above the normal sampling frequency given in table 1 until such time as the Quality Assurance Authority is satisfied with the degree of uniformity within batches.

5.3 Normal sampling frequency

5.3.1 For production by a manufacturer conversant by experience with a particular type of textile, sampling procedures shall be in accordance with 5.3.2 and table 1.

5.3.2 Samples shall not be taken from the first few metres of textile manufactured. For coated fabrics, the samples shall be taken from areas of the fabric well away from the ends. All fabric samples shall be full width.

5.4 Special arrangements for type testing. Certain specifications provide for the performance of special tests, type tests, at the outset of new production but require repeats of those tests on an infrequent, as distinct from a batch, basis. In such cases, the Quality Assurance Authority gives special directions regarding sampling. The Quality Assurance Authority may require type tests to be repeated at any time.

5.5 Testing. Except where otherwise required as part of the procedure of an individual test, all test samples or specimens cut therefrom shall be conditioned in accordance with clause 6.

With lightweight fabrics (up to 240 g/m²) manufactured wholly or partly from natural fibre and for all sewing threads, testing shall be completed without removal from the atmosphere specified in clause 6.

For all other textiles the test samples or specimens may be removed from the conditioned atmosphere for test purposes provided testing is complete within 15 min of such removal and the temperature is maintained in a draught-free environment.

In the case of dispute all testing shall be completed in the atmosphere specified in clause 6.

6. Conditioning

Unless otherwise specified in the individual test procedure, all test samples or specimens cut therefrom shall be freely exposed in an atmosphere of 65 ± 2 % relative humidity at a temperature of 20 ± 2 °C for not less than 6 h for uncoated fabrics weighing up to 240 g/m² and sewing threads, and not less than 16 h for other textiles.

7. Maintenance of identity

7.1 All textiles shall be kept identifiable during manufacture to enable final marking to be made in accordance with clause 8.

7.2 Test samples shall be kept identifiable with the textiles that they represent.

8. Final marking

8.1 All textiles, approved by the inspector, shall bear the mark of the inspector, markings to enable the items shown in table 2 to be identified and any additional markings specified in the appropriate textile specification.

For woven or knitted fabrics, the piece number shall also identify the weaver's or knitter's beam or warp or continuously manufactured 5000 m length, as appropriate, together with the position on the beam or warp or in the continuously manufactured length. For multi-width weaving, the transverse position as well as the normal longitudinal position shall be identified.

For coated fabrics, the constituent textile pieces shall be identifiable from the piece number.

NOTE. In addition to the markings specified in 8.1 textiles may also bear markings as specified in the contract or order.

8.2 The markings shall be legible and permanent.

8.3 For fabrics greater than 50 mm in width, the markings shall be on each piece, near to the outermost end.

For fabrics 50 mm or less in width, the markings shall be on either the fabric or a durable label which shall be securely attached to each separate roll.

For sewing threads supplied on cops of 250 g and above, the markings shall be on each individual cop. Cops less than 250 g shall be boxed and the markings shall be on the outside of the box.

For all other textiles, the markings shall be on a durable label which shall be securely attached to each separate length or package.

8.4 Marking media used for the final identification or other marking of textiles shall comply with appendix B where textiles bearing such markings are to be incorporated into manufactured stores or items.

Table 1. Normal sampling frequency

Textile	Normal sampling frequency
Woven fabrics including narrow fabrics: loomstate*	For fabrics woven from beams take one sample from one piece per beam. For fabrics woven from creels take one sample from one piece from each continuously woven length not exceeding 5000 m. If several narrow fabrics are woven simultaneously in the same loom, take one sample from each continuously woven length not exceeding 5000 m.
Knitted fabrics including narrow fabrics: loomstate	For warp knitted fabrics, take one sample from one piece per set of beams (i.e. each time a beam in a set is changed a further sample shall be taken). For weft knitted fabrics, take one sample from one piece from each continuously knitted length not exceeding 5000 m.
Woven or knitted fabrics including narrow fabrics: piece treated*†	For woven or knitted fabrics already proved by test in loomstate, take one sample from one piece per finisher's batch per fabric type and manufacturer. For woven or knitted fabrics not subject to test in loomstate, take one sample from one piece per weaver's or warp knitter's beam or each continuously woven or knitted length not exceeding 5000 m per finisher's batch. If a finisher's batch consists only of further pieces from a weaver's or a knitter's beams, or from continuously woven or knitted lengths previously proved by test in the finished condition, take one sample from one piece from the finisher's batch.
Coated fabrics, including narrow fabrics (e.g. fabrics spread coated or calendered with rubber)	Take one sample from one piece from each continuously coated length not exceeding 5000 m. If a continuously coated length comprises pieces from two or more weaver's or knitter's beams or continuously woven or knitted lengths, take one sample per beam or continuously woven or knitted length per continuously coated length.
Ropes	Take from each machine the number of samples given by: $S = 0.4 \sqrt{N}$ where S is the number of samples (to the nearest integer); N is the number of 220 m lengths from a machine. A minimum of one sample shall be taken from each machine.
Cords and lines	Take from each machine the number of samples given by: $S = 0.25 \sqrt{N}$ where S is the number of samples (to the nearest integer); N is the number of 250 m lengths from a machine. A minimum of one sample shall be taken from each machine.
Sewing threads	Take one sample from each thread batch or from each 25 kg whichever gives the greater number of samples.

* The quantity of fabric produced from one weaver's beam or from a creel contains the same warp yarns throughout and is woven in one particular loom. As such it constitutes a unique batch or unit of production, provided that weft yarn of substantially consistent quality has been used. If a fresh delivery of weft yarn of unproved quality is introduced during weaving the warp, a fresh batch has been created and further samples for complete fabric tests become necessary. Manufacturers should maintain continuous quality control of weft yarn in respect of the relevant properties, e.g. type of fibre, yarn count, strength.

† If a fresh delivery of yarn of unproved quality is introduced during weft knitting, a fresh batch has been created and further samples for complete fabric tests become necessary. Manufacturers should maintain continuous quality control of yarn in respect of the relevant properties, e.g. type of fibre, yarn count, strength.

Table 2. Marking requirements

	Loomstate fabrics	Finished fabrics	Coated fabrics	Braided cordage	Laid cordage	Sewing threads
Textile specification	X	X	X	X	X	X
Type or designation*	X	X	X	X	X	X
Firm(s) involved in manufacture	X	X	X	X	X	X
Piece number (see 8.1)	X	X	X			
Number of metres defective †	X	X				
Finisher's batch		X		X*		
Number of defects marked in accordance with appendix A			X			
Identification of cordage machine				X	X	
Batch or serial number				X	X	X
Number of portions (if more than one)	X	X	X			
Date (month and year) of coating			X			

* If applicable.

† Applicable to parachute fabrics only, see A.1.

Section two. Quality requirements

9. Manufacture

9.1 Wide fabrics

9.1.1 The fabric shall be uniformly manufactured.

9.1.2 The edges shall be straight, even and well made and shall not be substantially thicker than the body of the fabric.

9.1.3 The fabric shall lie flat on a table.

9.1.4 When supplied for subsequent coating, the fabric shall be such that it will continue to lie flat on a table when subjected to warpway tension.

9.2 Narrow fabrics

9.2.1 The fabric shall be uniformly manufactured.

9.2.2 The edges shall be straight and even.

9.2.3 If the edge structure is not specified in the appropriate textile specification, the edges shall not be substantially thicker than the body of the fabric.

9.2.4 In fabric of multi-ply construction containing binder warp threads, the binders shall be uniformly spaced in the width of the fabric.

9.3 Cordage

9.3.1 The strands of laid cordage shall be well formed and free from grooves and sunken yarns.

9.3.2 Each strand of laid cordage shall contain the same number of yarns.

9.3.3 Unless otherwise specified in the appropriate textile specification, laid cordage shall have Z lay.

9.3.4 Braided cordage shall be uniform in construction.

10. Dyed textiles

10.1 Coloured textile shall be dyed in accordance with the appropriate textile specification. The shade shall be to a standard authorized by the Quality Assurance Authority, e.g. to BS 381C.

10.2 Sulphur dyes shall not be used.

10.3 Dyes known to accelerate actinic damage shall not be used.

NOTE 1. The following are the colour index (C.I.) numbers of some of the dyestuffs that are known to accelerate actinic damage:

(a) to cellulose:

vat yellows	2, 3, 4, 9, 11, 14, 18, 21, 26 and 28
vat oranges	1, 2, 5 and 9
vat reds	1, 2, 42, 47 and 48
vat brown	5
vat violet	2

(b) to nylon 6.6:

acid red	211
mordant blue	49
disperse black	1

NOTE 2. The following are the colour index numbers of dyestuffs that, either alone or mixed together, are known to have a protective effect on nylon 6.6:

acid black	132
acid green	43
disperse yellow	3
disperse orange	3
mordant yellow	34

10.4 Unless otherwise specified in the appropriate textile specification, the fastness of the colour to light and the fastness of the colour to water or washing in respect of change of shade and of staining, when tested by the method described in the appropriate Section of BS 1006, shall be not less than the values given in table 3.

Table 3. Dye fastness requirements

Textile		Fastness to light		Fastness to washing/water	
		Method	Minimum standard	Method	Minimum rating
Clothing materials and sewing materials	Cellulosic and wool	BS 1006, Section B01 or BS 1006, Section B02*	6	BS 1006, Section C02	4
	Wholly or partly synthetic		4		4
Other textiles	Cellulosic and wool		5	BS 1006, Section E01	4
	Wholly or partly synthetic		4		4

* Referee method in the case of dispute.

In the case of dispute, the referee method of test for colour fastness to light shall be that described in BS 1006, Section B02.

10.5 Unless otherwise specified in the appropriate textile specification, for fabric intended for coating with natural or synthetic rubber, the fastness of the colour, in respect of change of shade, to vulcanizing in hot air and to vulcanizing in open steam shall be not less than rating 5 when tested by the methods described in BS 1006, Section S01 and BS 1006, Section S03 respectively.

NOTE to 10.4 and 10.5. Tests for dye fastness are designated as type tests; they are not required on mineral khaki treated fabrics.

11. Flammability*

11.1 When the flammability of a textile up to 70 mm in width is to be tested, the method to be used shall be that described in the appropriate textile specification, and when so tested the textile shall comply with 11.2 to 11.5.

When the flammability of a textile over 70 mm in width is to be tested, the method to be used shall, unless otherwise specified in the appropriate textile specification, be that described in 31.1, and when so tested the textile shall comply with 11.2 to 11.5.

11.2 The average burn length for the vertical strip test shall not exceed 200 mm.

11.3 The average of the sum of the after-flame and after-glow times shall not exceed 15 s.

11.4 The average flaming time of droplets from the specimen shall not exceed 5 s.

11.5 No individual test result shall exceed the average specified in the appropriate textile specification by more than 25 %.

11.6 Unless otherwise specified in the appropriate textile specification, a textile that has been subjected to a flame retardant treatment shall continue to meet the requirements of 11.1 after being subjected to domestic wash procedure 50 of BS 5651 : 1978.

11.7 If specified in the appropriate textile specification, a textile that has been subjected to a flame retardant

treatment shall continue to meet the requirements of 11.1 after being subjected to the dry cleaning procedure described in BS 5651 : 1978.

12. Dimensions and tolerances

12.1 General. Unless otherwise specified in the appropriate textile specification, the material shall comply with the requirements of 12.2, 12.3 and 12.4, as appropriate.

12.2 Wide fabrics

12.2.1 Overall width. The width shall be not less than that specified in the appropriate textile specification. Variation in width shall not exceed 13 mm.

NOTE. If loomstate fabric is subsequently to be processed (e.g. scoured, dyed or coated), allowance should be made for the consequent widthway shrinkage.

12.2.2 Length. Fabric for coating shall consist of continuous lengths of not less than 200 m, without gross defects and with not more than one butt seam per 200 m. No part shall be less than 40 m long.

For other fabrics, the minimum length of the loomstate piece shall be 100 m for those weighing 435 g or less per square metre, and 50 m for those weighing more than 435 g per square metre. Not more than 5 % of the pieces shall be in three parts, not more than 25 % of the remainder shall be in two parts and no part shall be less than 15 m long.

12.2.3 Weft skew and bow. Weft deviation from a line drawn perpendicular to the selvage shall not exceed 25 mm per metre width of fabric.

12.2.4 Warp bow. Warp bow shall not exceed 20 mm per 10 m length of fabric.

12.3 Narrow fabrics

NOTE. If a loomstate narrow fabric is subsequently to be processed (e.g. scoured, dyed or coated), allowance should be made for shrinkage in width and length.

12.3.1 Width. The width at any part shall be as specified in the appropriate textile specification, with the tolerances given in table 4.

* The performance requirements specified in this clause relate to the behaviour of specimens under the particular conditions of test and do not take into consideration the effects of ageing, washing, soiling, etc. that may be encountered during the life of the product. It has to be recognized that they do not give a full assessment of fire properties in all situations.

Table 4. Width tolerances: narrow fabrics

Nominal width of fabric	Tolerance
mm	
Less than 12.5	± 0.75 mm
12.5 to less than 55	± 1.5 mm
55 and over	± 4 %*

* Rounded up to the nearest 0.5 mm.

12.3.2 Length. The length of each roll shall be not less than 100 m. In each roll there shall be not more than four cuts (i.e. five parts) which shall not be joined by pins, metal fasteners or other means. No individual part shall be less than 9 m long. The total number of cuts in a consignment shall not exceed twice the number of rolls.

12.3.3 Warp bow. The warp bow, when measured on a 1 m length, shall not exceed 10 mm.

12.4 Length of cordage

12.4.1 Braided cordage shall be supplied in continuous lengths and shall be free from defects (see clause 14 and A.3). Braided cordage shall be made up on parallel wound reels or in balls with minimum tension, such that, when it is withdrawn from the package in the manner intended, the twist in the cordage does not exceed one-third of a turn per metre.

12.4.2 Laid ropes shall be supplied in continuous minimum lengths of 220 m neatly made into coils and tied with four or more clean lashings. Laid cords and lines shall be supplied made up in wound packages.

13. Freedom from corrosive impurities

Unless otherwise specified in the appropriate textile specification, the textile shall be free from corrosive impurities to the extent that:

(a) the conductivity of the aqueous extract does not exceed 15 mS/m;

or

(b) if this value is exceeded, e.g. owing to the presence of adventitious conducting but not specially corrosive matter, the pH value of the aqueous extract is not less than 5 or more than 8; water soluble chloride, expressed as sodium chloride, does not exceed 0.10 %; and water soluble sulphate, expressed as anhydrous sodium sulphate, does not exceed 0.25 %.

14. Freedom from defects

14.1 Defects. All textiles shall be examined for the presence of defects. Classification of the more common defects for certain broad groups of textiles are given in appendix A as follows.

A.1 Wide fabrics (other than coated fabrics)

A.2 Coated fabrics

A.3 Cordage

A.4 Woven narrow fabrics

The method of marking and acceptance limits for each of these groups of textiles shall be in accordance with the appropriate clause of appendix A, unless otherwise agreed by the Quality Assurance Authority.

14.2 Examination

14.2.1 Each piece of fabric shall be examined on both surfaces. With uncoated translucent fabric, one examination by transmitted light will suffice. Coated fabric required to be opaque shall be examined by transmitted light.

14.2.2 Each length of cordage shall be examined in single end form.

Section three. Physical tests

15. Determination of the number of threads, wales or courses per unit length in fabrics

15.1 Woven fabrics

15.1.1 Procedure. Determine the number of warp and weft threads using any one of the methods described in BS 2862 suitable for the textile under test.

15.1.2 Report. Calculate and report the results in accordance with BS 2862 and the appropriate textile specification.

15.2 Knitted fabrics

15.2.1 Procedure. Determine the number of visible wales and courses using any one of the methods described in BS 5441 suitable for the textile under test.

15.2.2 Report. Calculate and report the results in accordance with BS 5441 and the appropriate textile specification.

16. Mass

16.1 Wide fabrics

16.1.1 Procedure. With the sample laid flat and free from applied tension, cut a specimen from the full width of the fabric and not less than 500 mm long, or cut four specimens each 200 mm square. Measure the dimensions and weigh the specimen(s), each to an accuracy of 0.5 %, and calculate the mass per unit area, taking the average when four specimens are used.

16.1.2 Report. Report as required by the appropriate textile specification.

16.2 Narrow fabrics and cordage

16.2.1 Procedure

16.2.1.1 Except for the case described below, put a suitable length of the sample in tension equivalent to 1 % of the minimum breaking strength specified in the appropriate textile specification.

For laid 3-strand rope when the diameter or circumference is specified in the appropriate textile specification, put a suitable length of the sample in tension according to the following formula:

$$t = \frac{d^2}{8}$$

where

t is the tension equivalent to that exerted by a gravitational load in kilograms;

d is the diameter in millimetres.

16.2.1.2 After 60 ± 5 s, mark and accurately measure along the length in tension a specimen at least 1 m in length.

16.2.1.3 Release the tension, cut out the specimen and weigh it.

16.2.2 Report. Report as required by the appropriate textile specification.

17. Breaking strength and extension under load

17.1 General. Any method of test agreed with the Quality Assurance Authority may be used, but in cases of dispute the following method shall be used.

17.2 Apparatus. The apparatus required is a strength testing machine that complies with the requirements for grade A machines specified in BS 1610 in respect of accuracy and with (a) to (f) below.

(a) The load shall be applied to the specimen at a substantially constant rate.

(b) The rate shall be adjustable so as to apply the required specified breaking load in 60 ± 10 s.

(c) During the last 15 s of the loading time, the rate in successive 2 s intervals shall not vary by more than 50 % from the average.

(d) The breaking load shall fall within that part of the load range used that is verified correct within 1 % of that load.

(e) For fabrics, the grips shall be wider than the specimen, with edges parallel to each other and at right angles to the direction of pull, and shall be split matching halves, with serrated or wave profile, capable of receiving soft packing sheets to assist in gripping the specimen without causing damage.

NOTE. For narrow fabrics, cords, lines and sewing threads, the grips may be self-tightening bollards, or wedge grips with flat or wave profile, with provision for soft packings.

For ropes, the grips are, normally, self-tightening wedges, in split halves with inserts of diameter appropriate to the specimen and facilities for soft packings.

For synthetic ropes, sheet lead packings are recommended.

(f) The grips shall be adjustable in position to give initial test lengths as detailed in 17.4.

17.3 Preparation of specimens

17.3.1 Wide fabrics

17.3.1.1 Select the specimens from positions across the full width and length of the test sample on the principle illustrated in figure 1.

17.3.1.2 For uncoated fabrics, cut from the test sample ten rectangular specimens 55 mm by 300 mm to 400 mm, as convenient, five each with the longer side closely parallel to the warp and weft thread directions, and remove lengthways threads equally from each side of each specimen until the width is reduced to 50 mm, leaving the cross threads undisturbed.

If the number of widthway threads is fewer than 48 threads per centimetre, cut specimens 650 mm or wider in steps of 6.5 mm so that the width is 50 mm plus at least 2×15 thread spaces or 25 mm, whichever is the less.

17.3.1.3 For coated fabrics, cut from the test sample ten rectangular specimens 50 mm by 300 mm to 400 mm, as convenient, five each with the longer side closely parallel to the warp and weft thread directions.

17.3.2 Narrow fabrics

17.3.2.1 For fabrics up to 100 mm wide, cut from the test sample one full width specimen 300 mm to 400 mm long, as convenient.

17.3.2.2 For fabrics over 100 mm wide, cut from the test sample one specimen 55 mm by 300 mm to 400 mm, as convenient, with the longer side closely parallel to the warp thread direction, and remove lengthways threads

equally from each side of the specimen until the width is reduced to 50 mm.

17.3.3 Cordage. Test one specimen per test sample. If it is necessary to cut off the specimen from the test sample, avoid unravelling or distortion of the ends, e.g. by knotting, whipping or protecting the ends with wax or rubber tubing.

17.3.4 Sewing threads. Test five specimens per test sample. Draw off enough thread for the complete test length, first discarding 600 mm to 1 m at each end and also between each specimen. Avoid handling the central test length and take care not to insert or remove twist.

17.4 Procedure

17.4.1 Test the appropriate number of specimens, using for each specimen the procedure described in 17.4.2 to 17.4.5.

17.4.2 Clamp the specimen securely and evenly in the grips, set at the appropriate initial distance apart as follows, so that the specimen length is closely in the direction of pull.

Fabrics	200 mm
Silk and man-made continuous filament cords, lines and sewing threads	150 mm
Other cords, lines and sewing threads	250 mm
Natural fibre ropes	2 ± 0.2 m
Man-made fibre ropes	1 ± 0.1 m

17.4.3 If the extension under load is to be determined, mark two gauge points on the length between the grips, put the specimen in tension as described in 16.2.1.1 and measure the distance between the gauge points.

17.4.4 Operate the machine, in accordance with 17.2, so that the minimum load specified in the appropriate textile specification is applied in 60 ± 10 s. Record the maximum indicated load.

17.4.5 Measure the extension under load, if required, as the increase in the distance between the gauge points.

17.4.6 A result obtained with any specimen observed to slip or break in a grip and giving a lower figure than that specified in the appropriate textile specification shall be deemed invalid and a further specimen shall be taken and tested which, in the case of fabrics, contains the same longitudinal threads.

17.5 Report. Report the results, including any deemed invalid, as required by the appropriate textile specification. If the textile specification specifies a minimum for the average breaking strength(s), report the average breaking strength(s) as follows.

(a) *For wide fabrics:* the average of five valid results obtained along the warp direction or of five valid results obtained along the weft direction.

(b) *For sewing threads:* the average of five valid results.

18. Bursting strength

18.1 Apparatus. A suitable apparatus is shown diagrammatically in figure 2. It consists of a cylindrical brass pressure vessel (1) of 180 mm internal diameter, the top of which is closed by a thin sheet of rubber (3) of thickness 0.8 mm, on which a fibre ring (2), also of 180 mm internal diameter, can be clamped. Provision is made for a supply of air or water under pressure and for a gauge for indicating the pressure.

18.2 Preparation of specimens. Cut from the test sample six specimens, each 230 mm square. Select the specimens

from positions across the full width and length of the sample. If a 'wounded burst test' is specified, make a cut across the centre of three specimens with a clean sharp 12.5 mm chisel to sever the warp threads, and similarly make a cut in three specimens to sever the weft threads.

18.3 Procedure

18.3.1 When water is used as the pressure fluid, fill the vessel and lay the rubber on the base plate to exclude air bubbles.

18.3.2 Place a specimen centrally over the rubber sheet (all wrinkles having been carefully smoothed out), place the fibre ring over the specimen and securely clamp it.

18.3.3 Apply pressure at a steady rate, to reach the specified minimum bursting pressure in 60 ± 10 s, until the fabric bursts. Record the maximum pressure indicated.

18.3.4 Test the other five specimens as described in **18.3.1** to **18.3.3**.

18.4 Report. Report, as the bursting strength of each specimen, the maximum pressure indicated during the test on that specimen.

19. Tearing strength

19.1 Apparatus. The apparatus required is a strength testing machine that complies with the requirements for grade A machines specified in BS 1610 in respect of accuracy and with requirements (d), (e) and (f) of 17.2 and having a provision for separating the specimen grips at a substantially constant rate within the range 100 ± 12.5 mm/min.

19.2 Preparation of specimens. Cut from the test sample ten rectangular specimens each 230 mm by 150 mm, five each with the shorter side parallel to the warp and weft threads. In the middle of each specimen, cut a tongue 50 mm wide and 115 mm long with the cuts parallel to the lengthways threads and terminating at the same transverse thread so as to leave a 25 mm portion of cloth to be torn, as shown in figure 3.

19.3 Procedure. Set the specimen grips 180 mm apart and mount a specimen with the end of the tongue (T) in one grip and the base (B) of the specimen in the other. Operate the machine and record the maximum load indicated while the fabric is being torn as the tearing strength of the specimen.

Test the other nine specimens in the same manner.

19.4 Report. Report the average of the five results across warp and the average of the five results across weft.

20. Dimensional changes by cold water immersion*

20.1 Wide fabrics

20.1.1 Preparation of specimen. Cut from the test sample a specimen, not less than 450 mm square and clear of the selvages, and make three pairs of marks in the warp and weft directions, as shown in figure 4.

20.1.2 Procedure

20.1.2.1 With the specimen laid on a flat surface and covered with a sheet of plate glass, accurately measure the distance between each pair of marks.

20.1.2.2 Lay the specimen flat in water, at a temperature of 20 ± 2 °C and containing sufficient wetting agent,

and keep it about 25 mm below the water surface, using small weights as necessary.

20.1.2.3 After 2 h remove the specimen, allow it to dry on a flat surface at room temperature, and condition it as specified in clause 6.

20.1.2.4 Repeat the measurements through the plate glass.

20.1.3 Report. Report, as percentages, the mean changes in length in the warp and weft directions.

20.2 Narrow fabrics

20.2.1 Preparation of specimen. Cut from the test sample a full width specimen, not less than 450 mm long, and make a mark approximately 50 mm from each end.

20.2.2 Procedure

20.2.2.1 With the specimen laid on a flat surface and covered with a sheet of plate glass, accurately measure the distance between the marks; if a limit of relaxation shrinkage widthway is required by the appropriate textile specification, accurately measure the width at three approximately equidistant places along the specimen.

20.2.2.2 Proceed as described in **20.1.2.2** to **20.1.2.4**.

20.2.3 Report. Report, as percentages, the change in the length and, if appropriate, the mean change in the width.

21. Dimensional stability on heating

21.1 Dry heat

21.1.1 Wide fabrics

21.1.1.1 Preparation of specimen. Cut from the test sample a specimen not less than 300 mm square and mark it as described in **20.1.1**.

21.1.1.2 Procedure

21.1.1.2.1 With the specimen laid on a flat surface and covered with a sheet of plate glass, accurately measure the distance between each pair of marks.

21.1.1.2.2 Place the specimen in an oven at a temperature of 150 ± 2 °C, unless a different temperature is specified in the appropriate textile specification.

21.1.1.2.3 After 15 min, remove the specimen and condition it as specified in clause 6.

21.1.1.2.4 Repeat the measurements through the plate glass.

21.1.1.3 Report. Report, as percentages, the mean changes in length in the warp and weft directions.

21.1.2 Narrow fabrics

21.1.2.1 Preparation of specimen. Cut from the test sample a full width specimen not less than 450 mm long, and make a mark approximately 50 mm from each end.

21.1.2.2 Procedure. Make the measurements described in **20.2.2.1** and then proceed as described in **21.1.1.2.2** to **21.1.1.2.4**.

21.1.2.3 Report. Report, as percentages, the change in the length and, if appropriate, the mean change in the width.

21.2 Boiling water

21.2.1 Wide fabrics

21.2.1.1 Preparation of specimen. Cut from the test sample a specimen not less than 300 mm square and make three pairs of marks in the warp and weft directions as shown in figure 4.

* Formerly 'relaxation shrinkage in cold water'.

21.2.1.2 Procedure

21.2.1.2.1 With the specimen laid on a flat surface and covered with a sheet of plate glass, accurately measure the distance between each pair of marks.

21.2.1.2.2 Lay the specimen flat in water at the boil and keep it about 25 mm below the water surface, using small weights as necessary.

21.2.1.2.3 After 15 min in the boiling water, remove the specimen, allow it to dry on a flat surface at room temperature and then condition it as specified in clause 6.

21.2.1.2.4 Repeat the measurements through the plate glass.

21.2.1.3 Report. Report, as percentages, the mean changes in length in the warp and weft directions.

21.2.2 Narrow fabrics

21.2.2.1 Preparation of specimen. Cut from the test sample a specimen not less than 450 mm long, and make a mark approximately 50 mm from each end.

21.2.2.2 Procedure. Make the measurements described in 20.2.2.1 and then proceed as described in 21.2.1.2.2 to 21.2.1.2.4.

21.2.2.3 Report. Report, as percentages, the change in length and, if appropriate, the mean change in width.

22. Water repellency

22.1 Apparatus. The apparatus required is one of Bundesmann type that has been previously adjusted so that an empty testing cup of 100 mm diameter receives between 50 mL and 70 mL of tap water per minute at a temperature between 10 °C and 20 °C.

22.2 Preparation of specimens. From the test sample, cut four discs, each 141 mm in diameter, and weigh each to ± 0.01 g.

22.3 Procedure

22.3.1 Clamp the specimens over the testing cups of the apparatus and allow water to flow on them from the droppers.

22.3.2 After 10 min, or for such other period as is specified in the appropriate textile specification, remove each specimen in turn from the test cup, shake it very sharply six times, and either weigh it immediately or place it in a tared weighing bottle fitted with a stopper and weigh subsequently.

22.3.3 Measure, to the nearest millilitre, the volume of any water present in each cup.

22.4 Report. Report the following.

- (a) As penetration, the amount of water present in each cup.
- (b) As percentage absorption, the mean of the percentage increase in the mass of each of the four specimens, to the nearest whole number.

23. Sheath slackness and core looping of braided cordage

23.1 Preparation of specimen. From the test sample, take a specimen 2 m long, knot it firmly at each end and make a mark approximately 25 mm from one of the knots.

23.2 Procedure

23.2.1 Starting from the knot not adjacent to the mark, and using firm pressure, pass the cord between the thumb and finger of one hand so as to slide the sheath towards the other knot.

23.2.2 Measure the distance the mark has moved.

23.2.3 Fold the specimen into loops about 75 mm long and hold it completely in the palm of one hand.

23.2.4 Rub the looped specimen with the palm of the other hand, using a rotary motion with sufficient pressure to make the cordage roll about its axis, for 60 rubs at a rate of about 1 rub per second. The direction of rotation may be reversed periodically, if necessary, to retain the specimen between the hands.

23.2.5 Examine the cordage for signs of core threads having penetrated the sheath.

23.2.6 If there is no penetration but bulges or nodules are present, take two further specimens from different parts of the bulk supply from which the original sample was taken and subject each to the operations described in 23.2.3 to 23.2.5 to check for penetration.

23.3 Report. Report the following.

- (a) The distance moved by the mark, as measured in 23.2.2.
- (b) The results of the examination in 23.2.5.
- (c) If appropriate, the results of the two further tests in 23.2.6.

24. Plaits per unit length in braided cordage**24.1 Procedure**

24.1.1 Put a suitable length of the test sample in tension equivalent to 1 % of the minimum breaking strength specified in the appropriate textile specification.

24.1.2 After 60 ± 5 s, mark on the length in tension five separate specimens, each 25 mm long in the case of fine braided cordage with 20 or more plaits per 25 mm, or 75 mm long in other cases.

24.1.3 Count the number of plaits in each specimen.

24.2 Report. Calculate and report the average number of plaits per unit length as required by the appropriate textile specification.

NOTE. The unit length is normally 25 mm.

25. Turns per unit length in cordage (lay length)

25.1 Procedure. Put a suitable length of the test sample in tension as described in 16.2.1.1.

After 60 ± 5 s, mark and measure at three separate places the length containing ten complete spirals of one strand.

25.2 Report. Calculate and report the average of the three results, as required by the appropriate textile specification.

26. Turns per unit length held in strand in laid cordage

26.1 Preparation of specimen. Take, from not less than 1 m from either end of the rope, cord or line, a specimen of length in metres approximately equal to the number of strands.

26.2 Procedure

26.2.1 At the middle of the first metre of the specimen, firmly clamp a length of not less than 250 mm in suitable jaws and cut away and discard all but one of the strands.

26.2.2 Put the strand under test in tension equivalent to the load specified in 16.2.1.1 divided by the number of strands.

26.2.3 After 60 s measure the length. Determine the twist held in the strand by rotating one of the jaws until the

strand is untwisted, and counting the number of turns. Divide the number of turns by the length.

26.2.4 Test each of the other strands in turn, with a distance of approximately 1 m between each test length.

26.3 Report. Report the average of the determinations as the number of turns per unit length held in the strand.

27. Diameter and circumference of ropes

27.1 Procedure

27.1.1 Put a suitable length of the test sample in tension as described in 16.2.1.1.

27.1.2 Measure the diameter of the length in tension with a pair of calipers of suitable size, taking care to ensure that the jaws rest on the outside of the strands (see figure 5).

27.1.3 Repeat the measurement at two other positions along the sample.

27.2 Report. Report the diameter as the average of the three measurements or the circumference as calculated from that average, as required by the appropriate textile specification.

28. Air porosity of parachute fabrics

NOTE. Conditioning as specified in clause 6 is not necessary in the test described in this clause.

28.1 Apparatus. The apparatus* is shown diagrammatically in figure 6. It comprises a table with an orifice 38.43 mm in diameter through which air, at a pressure of 2.5 kN/m² (254 mm water gauge) may be blown through the fabric to be tested; a control for the adjustment of the air flow; manometers and Venturi tube; and a clamping head for the purpose of smoothing out any creases and holding the fabric evenly over the test orifice under a small radial tension.

28.2 Procedure. Carry out the following procedure at a temperature of not less than 18 °C.

Clamp the sample at ten places equally spaced across the full width of the fabric and take the reading on the air flow manometer in respect of each place in order across the fabric under an air pressure difference of 2.5 kN/m² (254 mm water gauge).

28.3 Report. Report as required by the appropriate textile specification the individual readings in the order of testing and the average of the ten readings, all rounded off to the nearest half unit for values up to and including 20, and to the nearest whole unit for values above 20.

29. Flexibility of fabrics

NOTE. The determination can be made by using a block of wood having an upper horizontal plane face and an inclined plane joining it at an angle of 150°.

29.1 Wide fabrics

29.1.1 Preparation of specimens. Cut from the test sample six rectangular specimens, each 250 mm by 25 mm, three each with the longer side closely parallel to the warp and weft thread directions.

29.1.2 Procedure

29.1.2.1 Lay a specimen on a smooth horizontal surface terminated at one end by a straight edge, so that the length

of the specimen is at right angles to, and one end is level with, that edge.

29.1.2.2 Move the specimen lengthwise over the edge, at a uniform rate of approximately 25 mm in 5 s, until the over-hanging end is 30° below the horizontal.

29.1.2.3 Measure the length of fabric protruding beyond the edge.

29.1.2.4 Make a similar determination with the other face of the same end of the specimen uppermost.

29.1.2.5 Test the other five specimens as described in 29.1.2.1 to 29.1.2.4.

29.1.3 Report. Report the average of the six measurements for the specimens cut in the warp direction and the average of the six measurements cut in the weft direction.

29.2 Narrow fabrics

29.2.1 Preparation of specimens. Cut from the test sample three specimens, each of about twice the maximum bending length specified in the appropriate textile specification and of full width.

29.2.2 Procedure. Test each specimen as described in 29.1.2.1 to 29.1.2.4.

29.2.3 Report. Report the average of the six measurements.

30. Doping properties

30.1 Apparatus. The apparatus required is two strong, rectangular, metal-reinforced wood frames of 250 mm x 250 mm internal dimensions, as shown in figure 7.

30.2 Preparation of specimens. Cut a specimen approximately 450 mm square from both the test sample and a sample of standard reference fabric†.

30.3 Procedure

30.3.1 Clamp two adjacent edges of the specimen cut from the test sample with the warp and weft threads parallel to the sides of a frame and apply a load to each of the other two edges to give a tension equivalent to a force of 350 N per metre width in the warp direction and a tension equivalent to a force of 175 N per metre width in the weft direction.

30.3.2 Fix the fabric, while still under tension, to the frame (e.g. by tacks) and cut away the excess fabric round the frame.

30.3.3 Apply evenly by brush one coat of red oxide tautening dope complying with British Standard X 26.

30.3.4 After 1 h, examine the doped fabric for dryness and freedom from discoloured patches or bubbles.

30.3.5 Apply evenly further coats of the dope by brush or spray to give an added film mass of 120 ± 20 g per square metre.

30.3.6 Fix and treat, as described in 30.3.1 to 30.3.5, the specimen of standard reference fabric.

30.3.7 Compare, visually, the doped test specimen with the doped standard specimen for drying rate, evenness, penetration and smoothness.

30.4 Report. Report the comparison between the specimens as required by the appropriate textile specification.

*Apparatus complying with Royal Aircraft Establishment Drawing Aero 1582.

† For UK Services use, samples may be obtained on application to the Director of Aeronautical Quality Assurance, P.O. NM.2, Aeronautical Quality Assurance Directorate, Harefield House, Harefield, Middlesex.