Information processing — Unpunched paper tape — Specification

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FOREWORD

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO Member Bodies). The work of developing International Standards is carried out through ISO Technical Committees. Every Member Body interested in a subject for which a Technical Committee has been set up has the right to be represented on that Committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

Prior to 1972, the results of the work of the Technical Committees were published as ISO Recommendations; these documents are now in the process of being transformed into International Standards. As part of this process, Technical Committee ISO/TC 97, *Computers and information processing,* has reviewed ISO Recommendation R 1729-1971 and found it technically suitable for transformation. International Standard ISO 1729 therefore replaces ISO Recommendation R 1729-1971, which was approved by the Member Bodies of the following countries :

Belgium	Greece	Sweden
Brazil	Iran	Switzerland
Canada	Italy	Thailand
Czechoslovakia	Japan	Turkey
Egypt, Arab Rep. of	New Zealand	United Kingdom
France	Romania	U.S.A.
Germany	Spain	

No Member Body expressed disapproval of the Recommendation.

Information processing — Unpunched paper tape — Specification

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies the characteristics of paper tape to be used for data interchange, when the tape is in the unpunched condition.

2 REFERENCES

ISO/R 1974, *Paper — Determination of tearing resistance.*

ISO/R 2144, *Paper and board — Determination of ash.*

3 TEST CONDITIONS AND METHODS OF TEST

3.1 Sampling

Sampling shall be carried out in accordance with the procedures described in annex A unless otherwise agreed between customer and supplier.

NOTE — It is important to recognize that the majority of the physical properties will be tested by the paper maker and the paper tape coil converter. Since the quantity of paper involved is usually quite large, it is necessary to adopt a balanced sampling procedure and often to report the result in terms of a mean value and a permissible deviation.

3.2 Test conditions

The test conditions for measurement shall be the following :

— relative humidity (R.H.) 50 ± 2 %

— temperature $23 \pm 2\,^{\circ}$C $(73 \pm 3.5\,^{\circ}$F)

NOTE — It is accepted that some paper manufacturers normally test at 65 % R.H. and it will be necessary for them to make allowances to ensure that the values of width and thickness indicated in clause 4 are attained at 50 % R.H. and 23 °C (73 °F).

3.3 Conditioning of test samples

Samples shall be conditioned prior to test in accordance with the procedures described in annex B.

3.4 Methods of test

Tests shall be carried out in accordance with the methods standardized by Technical Committee ISO/TC 6, *Paper, board and pulps*. Until the appropriate International Standards are published, the test methods specified in annexes C to J shall apply.

4 DIMENSIONS

4.1 Width

The width of the unpunched tape shall be :

	mm	in
Nominal width	25,40	1.000
Tolerance :		
95 % of samples	± 0,05	± 0.002
100 % of samples	± 0,08	± 0.003

4.2 Thickness

The thickness of the unpunched tape shall be :

	mm	in
Nominal thickness	0,100	0.004 0
Tolerance :		
95 % of samples	± 0,008	± 0.000 3
100 % of samples	± 0,010	± 0.000 4

5 CHEMICAL PROPERTIES

5.1 pH value

The pH value shall be $6 \pm 1,5$.

NOTE — It is desirable that the pH value of the paper be as high as possible within these limits.

For measurement of pH value, see annex E.

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5.2 Ash content

The ash content shall not exceed 1 %.

The ash content shall be determined by the method specified in ISO/R 2144.

5.3 Grit content

The grit content shall not exceed 0,04 %.

For determination of grit content, see annex F.

5.4 Lubricating additives

In order to ensure the minimum wear of the punch elements, the tape may have lubricating additives. The percentage of lubricating additives will depend largely on the type(s) of lubricant(s) used. It is important that the lubricant should not adversely affect the properties of the paper tape as defined elsewhere in this International Standard.

NOTE — It has been observed that silicone oils can cause paper tape to have corrosive properties.

5.5 Composition and quality

The paper shall be free from mechanical (ground wood) pulp, holes, slime spots, shives, unbeaten fibres, fluff, dust, grit and abrasive particles. In addition, it is important that the lignin content be kept to a minimum and that the tapes be free from translucent spots and any other defects which would interfere with reading or punching.

6 PHYSICAL PROPERTIES

6.1 Paper substance

The substance shall be 76 to 94 g/m² (0.25 to 0.31 oz/ft²). This refers only to unoiled paper tape.

For determination of paper substance, see annex G.

6.2 Strength

6.2.1 *Static tensile strength* shall be measured in the machine direction. The mean value shall be not less than 177 N (18,1 kgf) per 25,4 mm of width (40 lbf per inch of width). In addition, the arithmetic mean of the results less twice the standard deviation shall be not less than 156 N (15,9 kgf) per 25,4 mm of width (35 lbf per inch of width).

For determination of static tensile strength, see annex H.

6.2.2 *Internal tear resistance* in both the machine direction and the cross direction shall be not less than 0,56 N (55 gf).

The internal tear resistance shall be determined by the method specified in ISO/R 1974.

6.3 Dimensional stability

6.3.1 The maximum variation of the dimension in the cross direction when the relative humidity is varied from 20 % to 75 % and also when it is varied from 75 % to 20 % shall not exceed 1 % of the length measured at 50 % R.H.

6.3.2 Under the same changes of relative humidity the maximum variation of the dimension in the machine direction shall not exceed 0,5 % of the length measured at 50 % R.H.

6.3.3 For measurement of dimensional stability, see annex J.

6.4 Percentage of light transmission

The maximum value of light transmission shall not exceed 50 %.

For measurement of light transmission, see annex K.

6.5 Electrical properties

Bulk conductivity. For the purpose of sensing, the paper shall act substantially as an insulator when placed between two low-voltage sensing contacts.

6.6 Printability

The surface of the oiled tape shall legibly accept and retain interpretive printing, handwriting by means of ordinary pen nib or ball-point pens using commercial quality inks, lead or coloured pencils, and rubber stamping. The legibility of both manuscript and print shall not be adversely affected by either the type of material or the finish.

6.7 Colour

The paper tape may be of any colour, provided that all the specifications of this International Standard are satisfied.

6.8 Pre-printing

Tapes may be pre-printed if required, provided that each tape after printing meets all the requirements of this International Standard.

6.9 Quality

The paper shall be free of slime spots, pin holes, translucent spots, holes, tears, wrinkles and creases. The paper shall also be as free of lint, fuzz and dust as the best manufacturing practices permit.

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7 COILING

7.1 Inner diameter

The inner diameter of the core shall be :

	mm	in
Nominal	50,8	2.000
Tolerance	+ 1,6 / 0	+ 0.063 / 0

7.2 Outer diameter

The outer diameter of a coil of unpunched tape shall be :

	mm	in
Nominal	203	8.00
Tolerance	0 / − 3	0 / − 0.12

7.3 End of paper tape marker

7.3.1 Each coil of tape shall be marked with a pink or red warning mark (but a contrasting colour on pink or red tapes).

7.3.2 The length of this mark shall be about 6 m (20 ft) and there shall be an unmarked length of about 3 m (10 ft) from the inner end of the coil.

7.3.3 The colouring matter of the marker shall be non-adhesive, non-abrasive and non-poisonous.

7.4 If the tape is fastened to the core, it shall not require a tension of more than 4 N (400 gf or 14 ozf) to pull it off the core.

7.5 The face of the coils shall be as clean and smooth, free from dust and undamaged as the best manufacturing process will permit. The coils shall unwind freely without sticking.

7.6 Tightness of coiling

Each coil shall be wound evenly and sufficiently tightly on the core that it does not telescope with normal handling.

ANNEX A

METHOD OF SAMPLING PAPER TAPE FOR TESTING

(Based on ISO/R 186, *Method of sampling paper and board for testing*)

A.1 SCOPE AND FIELD OF APPLICATION

This annex specifies a method of obtaining a representative sample of a lot of coils of paper tape for test purposes.

For certain tests, special methods of sampling will be given in the text of the appropriate method of test.

NOTE — If, at the time of sampling, less than 50 % of the lot remains, sampling will be invalid in the absence of agreement to the contrary.

A.2 DEFINITIONS

A.2.1 consignment : One or more lots.

A.2.2 lot : The aggregate of paper of a single kind, of specified characteristics, for example a box of coils.

A lot comprises one or more similar units, for example coils.

A.2.3 specimens : Rectangles of paper cut to given dimensions, from the selected units.

A.2.4 sample : All the specimens.

A.2.5 test piece : The quantity of paper on which the test is carried out in accordance with the stipulations of the method of test.

It may be taken from a specimen; in certain instances, the test piece may be the specimen itself, or several specimens.

A.2.6 selected at random : Taken in such a way that each part of the whole has an equal chance of being selected.

Lot	(Box of coils)
Unit Unit Unit	(Coils)
Test piece Specimen	(Length of tapes)
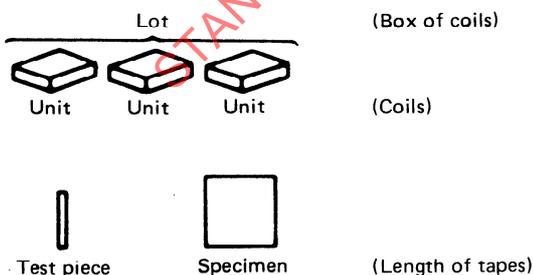
A.3 PRINCIPLE

Withdrawal of a certain number of units from each lot. Taking of a certain number of specimens from each of these units. In general, obtaining from these specimens the test pieces necessary for the various tests.

A.4 PREPARATION OF SPECIMENS

A.4.1 Selection of units

The units to be sampled should be selected according to the following table :

Size of lot (n) units	Number of units selected	Method of selection
1 to 5	all	—
6 to 99	5	at random
100 to 399[1]	n/20	at random
400 or more	20	at random

1) In deciding the number of units to be selected, any remainder of less than 20 units should be ignored.

The units selected should be intact and in good external condition.

A.4.2 Selection of specimens

For each unit withdrawn from the lot, proceed as follows :

Take the length of paper tape from each coil, as long as necessary for the tests requested.

The selection of the length of tape from the coils is made as follows :

Remove all damaged layers of paper from the outside of the coil (if any); discard in all cases at least three undamaged layers; remove the requisite length of tape.

A.4.3 Size of specimens

It is recognized that only a limited range of tests can be performed on the specimens obtained by this method.

A.5 ADDITIONAL REQUIREMENTS

A.5.1 Specimens

A.5.1.1 *Precautions*

Specimens should be kept flat, free from wrinkles and folds and protected from exposure to direct sunlight, liquids, varying humidity conditions and any other harmful influences. Care should be taken in handling specimens, as

contact with the hands can appreciably affect the chemical, physical, optical, surface or other characteristics of the paper.

A.5.1.2 *Marking*

Each specimen should be provided with identification marks, this being necessary to ensure that it can be recognized beyond all doubt. These marks should be indelible; they may be limited to the number of the sampling report and the signature of the sampler. They should be in one corner and as small as possible.

A.5.2 Re-sampling

A.5.2.1 If, as a result of an accident during sampling or testing, re-sampling is necessary, a new sample should be taken according to the rules set out above; unless otherwise indicated, the selection may be made from the same units as before.

A.5.2.2 In other circumstances, should re-sampling be deemed necessary, it is recommended that the parties concerned should agree upon the procedure to be adopted, with due regard for the principles specified above.

A.6 SAMPLING REPORT

The sampling report should state

a)   the name of the person drawing the sample;

b)   the name and address of the purchaser and the name of his representative;

c)   the name and address of the supplier and the name of his representative;

d)   the size of the lot;

e)   the constitution of the lot;

f)   if necessary, the references of the lot and of the units;

g)   the conditions in which the lot appears;

h)   number of specimens constituting the sample;

i)   the procedure employed;

j)   all the circumstances of such nature as to influence results of the future tests;

k)   the date of the operations;

l)   the place of sampling;

m)   a reference corresponding to that indicated on the sample;

n)   any deviation from this method of sampling.

ANNEX B

METHOD FOR THE CONDITIONING OF PAPER TEST SAMPLES
(Based on ISO/R 187, *Method for the conditioning of paper and board*)

B.0 INTRODUCTION

This annex specifies a conditioning method which should be considered as the standard method in the absence of any previous agreement.

The physical properties of paper are affected materially by its moisture content which, in turn, is dependent on the humidity of the surrounding atmosphere. In order that tests may be made on paper in a defined physical state, it is brought into equilibrium with an atmosphere of standardized temperature and relative humidity and is tested in that atmosphere.

The moisture content of a given paper in equilibrium with a given atmosphere varies according to whether the equilibrium is reached by sorption or desorption of moisture. This hysteresis influences those physical properties that change with moisture content; it is recommended that the equilibrium condition be attained by a sorptive process.

B.1 SCOPE AND FIELD OF APPLICATION

This annex specifies the conditioning atmosphere and the method of conditioning paper before and during testing.

B.2 DEFINITIONS

B.2.1 relative humidity (R.H.) : Ratio of the absolute humidity of the air to the humidity of air saturated with water vapour at the same temperature and pressure.

NOTE — The ratio is usually expressed as a percentage. At ordinary atmospheric temperatures, this ratio is almost exactly equal to the ratio of the actual vapour pressure to the saturation vapour pressure at the same (dry bulb) temperature.

B.2.2 conditioning : For the purpose of this method, paper samples are conditioned when they are in equilibrium with a conditioning atmosphere. This equilibrium is considered to be attained when, after determining the masses of the samples at intervals of not less than 1 h, the last two weighings do not differ by more than the specified amount.

The establishment of moisture equilibrium is accepted as ensuring that the paper is in a stable physical state, but in special cases, conditioning may have to be prolonged until the desired physical equilibrium is attained. Such cases are not within the scope of this method.

B.3 PRINCIPLE

Exposure of the samples to a conditioning atmosphere in such a manner that a state of moisture content equilibrium is reached between the paper and this atmosphere.

B.4 CONDITIONING ATMOSPHERE

Temperature	23 ± 2 °C (73 ± 3.5 °F)
Relative humidity (R.H.)	50 ± 2 %

B.5 EQUIPMENT

B.5.1 Room and measuring instrumentation

The room in which conditioning is carried out should be provided with automatic equipment for bringing the air to standard conditions of relative humidity and temperature and so circulating it that the conditions at all relevant points are uniformly maintained within it. It is recommended that a recording hygrometer, periodically checked by a standard method (for example, with wet and dry bulb thermometers), be kept in the test space for checking purposes.

B.5.2 Determination of temperature and relative humidity

The relative humidity of the conditioning air should be determined by a reliable method. Where a wet and dry bulb hygrometer is used, it should be placed in an air current of the speed required by the tables used. This should be not less than 2 m/s (6.6 ft/s).

When the two thermometers of the hygrometer are at the same temperature, their bulbs being dry, the difference in reading should not exceed 0,2 °C (0.36 °F).

B.6 PROCEDURE

B.6.1 Preliminary treatment of samples

For tests in which the hysteresis of the equilibrium moisture content may lead to important errors, the samples should be desiccated before conditioning, for 24 h in air of relative humidity between 20 and 30 % and a temperature not above 40 °C (104 °F).

B.6.1 Conditioning

The specimens should be so suspended that the conditioning air has free access to all their surfaces until they reach equilibrium moisture content. This equilibrium is considered to be attained when the two last weighings do not differ by more than 0,25 % of the total mass (see B.2.2).

NOTE — With good air circulation, a conditioning period of 4 h is usually sufficient. Certain special paper tapes, including those made water resistant, may require much longer periods.

B.7 TEST REPORT

The test report should state

a) the nominal value and the specified limits of the relative humidity and temperature of the conditioning atmosphere;

b) the time taken to condition the paper;

c) whether the paper was desiccated before conditioning.

ANNEX C[1]

MEASUREMENT OF WIDTH

It is recommended that the width be measured by an optical method, care being taken that the source of illumination does not heat the tape.

ANNEX D[1]

MEASUREMENT OF THICKNESS

It is recommended that the thickness be measured using a micrometer exerting a pressure of 1 daN/cm² (14.22 lbf/in²) and having an anvil size of approximately 2 cm² (0.31 in²).

ANNEX E[1]

MEASUREMENT OF pH VALUE

It is recommended that the pH value be measured by a hot extraction method.

Suitable methods are described in the following national standards :

France	—	NF	Q 03-005 (May 1957)
Germany	—	DIN	53124 (Dec. 1960)
United Kingdom	—	BS	2924
U.S.A.	—	ASTM	D 778-50 (and TAPPI T 435)

ANNEX F[1]

DETERMINATION OF GRIT CONTENT

Two basic techniques for determining the grit content are in widespread use : one method is based on combustion of a dry paper sample and the other method involves a wet digestion process.

Typical descriptions of these methods are detailed in BS 3880 Part II, Appendix B, and US Working Paper 97/4/3 (U.S.A. — 15) 125, Paragraph 6.2.

At this time, it is considered that both processes would be acceptable as the basis of grit determination.

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1) See 3.4, page 1.

ANNEX G[1]

DETERMINATION OF PAPER SUBSTANCE
(Based on ISO/R 536, *Determination of paper substance*)

G.1 SCOPE AND FIELD OF APPLICATION

This annex specifies the method of determining the paper substance.

G.2 DEFINITION

substance : The mass of a paper, expressed in grams per square metre (g/m²), determined under standard test conditions.

For the purpose of testing unpunched paper tape the standard test conditions are those described in annex B.

The result is considered "standard" only when these test conditions include conditioning according to annex B.

G.3 PRINCIPLE

Measurement of the area and mass of the test pieces and calculation of the mass per square metre, all measurements being made on conditioned test pieces.

NOTE — Alternatively, the mass per square metre may be determined for other conditions, for example :

    a) **oven dry :** measurements of area are made in the conditioned state and the mass is determined after oven drying, according to ISO/R 287, *Method for the determination of moisture content of paper (Oven-drying method);*

    b) **as taken :** measurements of area are made on test pieces cut out and weighed without previous conditioning.

When the specimens have to be taken from a reel, they should be cut at such a depth that they are not affected by any abnormal gain or loss of moisture compared with the remainder of the unit.

G.4 APPARATUS

G.4.1 Cutting device

The cutting device should normally be capable of repeatedly cutting out test pieces whose area, in at least 95 cases out of 100, is within 1 % of a known area. This should be checked frequently by the method given below and, provided that the above accuracy is attained, the mean area obtained in these check tests should be used for calculating substance.

With certain types of paper it will be found, after carrying out this determination of area, that test pieces cannot be cut with the accuracy just defined and, in such cases, the area of every test piece should be determined individually.

Checking of cutting device. The area cut should be checked frequently by measuring 20 test pieces and calculating their areas (see second paragraph of G.7). The cutting accuracy specified above is attained when the standard deviation of the individual areas is below 0,5 % of the mean area, in which case this mean area should be used for calculating substance in subsequent tests. If the standard deviation exceeds this value, the area of every test piece should be determined individually.

G.4.2 Weighing device

The weighing device should be accurate enough, over the range of mass for which it is used, to measure always to the nearest 0,5 % of the actual mass. It should be sensitive enough to detect a change of ± 0,2 % of the mass to be weighed and, if the device is of the direct reading type, it should be graduated so that readings may be taken to this degree of accuracy.

Special sheet-weighing devices, designed to weigh test pieces of a given size and indicating substance in grams per square metre, may be used, provided that the above conditions are fulfilled and that the area of each test piece in a single weighing is not less than 500 cm² (see G.7 and G.8.2).

When in use, the weighing device should be shielded from air currents.

Checking of weighing device. The weighing device should be checked frequently by applying accurately measured masses with both increasing and decreasing loads.

G.5 SAMPLING

The selection of units and sheets and the taking of specimens should be carried out in accordance with annex A.

The number of specimens taken should be at least five and their combined area should be sufficient for at least 20 test pieces.

G.6 CONDITIONING

The test pieces should be conditioned in accordance with the method described in annex B.

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1) See 3.4, page 1.

G.7 PROCEDURE

Take at least 20 test pieces in all from at least five conditioned specimens, if possible the same number from each specimen, each test piece having an area of not less than 500 cm².

Determine the area of the test piece by calculation from measurements taken to the nearest 0,5 mm.

If the accuracy of the cutting device does not satisfy the requirements of G.4.1, the dimensions of each test piece should be measured.

Weigh each test piece.

G.8 CALCULATION AND EXPRESSION OF RESULTS

The results should be expressed in grams per square metre to three significant figures.

G.8.1 Having followed the procedure described in G.7, calculate the substance of each test piece according to the following formula :

$$X = \frac{m}{A} \times 10\ 000$$

where

X is the substance, in grams per square metre;

m is the mass, in grams, of the test piece;

A is the area, in square centimetres, of the test piece.

G.8.2 If a calibrated sheet-weighing device as described in G.4.2 is used, then the substance is given by the following formula :

$$X = \frac{A'}{A} \times X'$$

where

X is the substance, in grams per square metre;

X' is the indicated substance, in grams per square metre, of the test piece;

A' is the area, in square centimetres, of test piece for which the device is calibrated;

A is the area, in square centimetres, of weighed test piece.

G.8.3 Calculate the mean of the results.

G.9 TEST REPORT

The test report should state

a) the mean of the substance;

b) the number of tests;

c) the standard deviation[1].

If specimens have been taken from more than one position across a reel or sheet and information on substance variation is required, the above results should be reported for each position separately.

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1) It is suggested that, in addition, the accuracy of the mean (confidence limits), at the 95 % probability level, should be quoted for information.

ANNEX H[1]

DETERMINATION OF STATIC TENSILE STRENGTH

H.1 TEST PARAMETERS

This test should be performed on a pendulum or strain gauge instrument. The test is required in the machine direction only and the following test parameters will apply :

1) Width of strip :

   Not less than 16 mm (5/8 in).

2) Length of strip :

   178 mm (7 in).

3) Speed of lower clamp :

   Operate the tester so that the average time for the completion of the test will be not less than 5 s and not greater than 20 s.

4) Number of readings required :

   Break at least 10 strips.

5) Units :

   Express tensile strength as the load in newtons (or kilograms-force) required to break a strip of paper 25,4 mm wide, or the load in pounds-force required to break a strip 1 in wide.

H.2 TEST REPORT

The test report should state

a) the mean tensile strength;

b) the standard deviation;

c) the number of strips tested;

d) the width of strips tested;

e) the mean minus twice the standard deviation.

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1) See 3.4, page 1.

ANNEX J[1]

MEASUREMENT OF DIMENSIONAL STABILITY

J.1 SCOPE AND FIELD OF APPLICATION

This annex is concerned with the measurement of the change in planar dimensions of the paper from which paper tape is produced, as a result of changes in the ambient relative humidity.

J.2 TEST ATMOSPHERE

J.2.1 The necessary apparatus should be enclosed in a suitable chamber inside which the ambient atmosphere can be controlled.

J.2.2 All measurements of length of test pieces should be made without disturbing this ambient atmosphere.

J.2.3 Atmospheric conditions should be as follows :

— upper relative humidity : 75 ± 2 %

— lower relative humidity : 20 ± 2 %

— temperature : 23 ± 2 °C (73 ± 3.5 °F)

— speed of flow of conditioned air over surface of test pieces : not less than 1,5 m/min (5 ft/min).

J.3 TEST PARAMETERS

1) Width of strip :

    Not less than 15 mm (0.6 in).

2) Length of strip :

    Not less than 100 mm (4.0 in).

3) Duration of test :

    Condition for 30 min after required ambient atmospheric conditions have been attained.

4) Load on strip :

    Not greater than 0,2 N (20 gf) per 25,4 mm width of strip (0.70 ozf per inch of width). No tensile load to be applied to strip during conditioning period.

5) Precision of measurement :

    Position of movable end of test piece to be measured to ± 0,01 % of nominal length of test piece.

6) Number of tests required :

    At least 10 in the specified direction.

J.5 TEST REPORT

The test report should state

a) the mean change in length of strips arising from the change in ambient relative humidity from 20 to 75 %, expressed as a percentage of the length of the test piece at 50 % R.H.;

b) the standard deviation of the change in length;

c) the number of strips tested;

d) the width of strips tested;

e) the mean ± 2σ.

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1) See 3.4, page 1.

ANNEX K

MEASUREMENT OF LIGHT TRANSMISSION

K.0 INTRODUCTION

The description given in K.1 and K.2 outlines the general principle of a test apparatus and test method to be employed when measuring the light transmission property of paper tape. The essential elements of such an apparatus are shown in figure 1 and consist of

- the light source,
- the light path,
- the mask geometry,
- the photocell device,
- the measuring instrument.

The method of test has been established because it simulates the more critical factors of typical paper tape photo-electric reading equipment and can be carried out with an apparatus which can be defined in all its important respects.

K.1 DESCRIPTION OF THE TEST APPARATUS

K.1.1 Radiation (light) source

A tungsten bulb is used as light source and should be energized such that it operates in an under-run condition.

Typically, an operating temperature of 2 000 K should be used and the resultant illumination of the working plane should be approximately 5 000 lx.

K.1.2 Optical path

The light should fall nominally perpendicular on the test paper and be of substantially uniform intensity. Typically, the lamp paper distance d (see figure 1) may be 150 mm (5.9 in).

An intermediate mask of the form shown in figure 1 should be incorporated in order to ensure sensibly that scattered light does not enter the measuring mask area.

K.1.3 Measuring mask geometry

The measuring mask should be constructed in one piece according to the drawing shown in figure 2. A good matt black finish capable of absorbing infra-red radiation is necessary. Special care must be taken to ensure that the paper tape to be measured is maintained flush with the outer face of the measuring mask.

K.1.4 Photocell device

A flat silicon photocell should be employed for radiation measurement. The dimensions must be such that the active area of the photocell exceeds the diameter of the larger mask orifice and that it be mounted flush with the mask face.

K.1.5 Measuring instrument

The measuring instrument should be connected directly across the photocell to measure the short-circuit current. The load impedance of the photocell should not exceed 500 Ω. The measuring instrument, which could take the form of a moving-coil meter with a full scale deflection of 0,05 mA, should be capable of resolving to 1 % and should have a nominal accuracy of ± 1,5 %.

K.2 PROCEDURE

The percentage light transmission value should be determined as the statistical maximum value according to the following formula :

$$T_{\max} = \overline{X} + \Delta + 3\sigma$$

where

$\overline{X}$ is the mean value of n observations;

σ is the standard deviation;

$$\Delta = \frac{3\sigma}{\sqrt{n}} \text{ for } n \geqslant 30$$

The reading instrument should be set to full scale deflection initially.

For the purpose of the the test a sample strip of paper not less than 250 mm (10 in) long should be inserted in the measuring instrument and not less than 30 sample points should be recorded.

K.3 GUIDANCE ON CONSTRUCTION

K.3.1 When selecting the lamp, care must be taken to ensure that no optical inhomogeneities occur in the glass bulb. If mirrors or lenses are used they must be placed so that no filament image occurs in the proximity of the mask and photocell area.

K.3.2 Special attention must be paid to all surfaces parallel to the light path and in close proximity to the mask and photocell to ensure that no substantial reflection of light occurs. Similarly, the method of feeding the paper must ensure that no light leakage occurs through any slot arrangement.

K.3.3 The accuracy of the measurement is dependent not only on attaining the dimensional tolerances shown in figure 2 but also on the coating of the surfaces, which must be a high quality optical matt black paint. Chemical methods are unlikely to prove satisfactory. The mask should be checked after coating, to ensure that the small hole remains in tolerance.

The method of constraining the paper must ensure that the paper maintains a flush relationship with the face of the mask and yet allows the paper to be moved without physically damaging or distorting it.

K.3.4 The photocell must be mounted with care, taking special precaution that the photocell leads do not interfere with the flush mounting arrangement. It is advisable to mount the cell in some slightly resilient arrangement to ensure that the face of the photocell presses lightly on the back of the mask.

K.4 GUIDANCE ON USE

K.4.1 It will normally be found necessary to drive the bulb through a constant voltage transformer or similar stabilized power supply.

K.4.2 The measuring meter should be connected across the photocell. The lamp supply or a small shunt potentiometer across the meter should be adjustable in order to set the meter reading to read exactly full scale deflection (100 %).

The paper tape sample should then be inserted and the meter readings noted for at least 30 positions along the tape. The tape sample should then be withdrawn and full scale deflection should be checked. If the latter reading lies outside the range 99 to 101 % the procedure should be repeated and a new set of values obtained.

K.4.3 Occasionally the light meter should be checked and cleaned to ensure that no paper dust has accumulated.