INTERNATIONAL STANDARD

ISO 11798

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Information and documentation — Permanence and durability of writing, printing and copying on paper — Requirements and test methods

Information et documentation — Permanence et durabilité de l'écriture, de l'impression et de la reprographie sur papier — Prescriptions et méthodes d'essai

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Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established 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. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11798 was prepared by Technical Committee ISO/TC 46, *Information and documentation*, Subcommittee SC 10, *Physical keeping of documents.*

Annexes A and B form an integral part of this International Standard. Annex C is for information only.

Introduction

Writing materials and equipment meeting the requirements given in this International Standard can be used in the preparation of paper documents with stable and durable images, i.e. images likely to undergo little or no change in properties that influence legibility and the possibility of copying or converting the paper documents to other data carriers, e.g. microforms.

It is primarily intended for writing, printing, and copying on writing and printing papers and also on photo-copying papers.

This International Standard specifies requirements and testing methods for evaluation of the stability of images. Some properties of an image, e.g. resistance to wear, depend on the combination of the image and the paper. Permanent papers (ISO 9706) and archival papers (ISO 11108), used in the preparation of documents, may differ widely in properties of importance for the quality and permanence of the image. The testing conditions of this International Standard are chosen so that results, representative of the majority of papers on the market to be used for a particular imaging process, shall be obtained.

In this International Standard, the requirements are given in terms of

— image colour strength and appearance;

— lightfastness;

— water resistance;

— transfer of recorded image;

— resistance to wear;

— resistance to heat;

— effect of recording on the mechanical strength of the paper.

More rigorous limiting values and other requirements than those set out in this International Standard may be required when testing material and machinery intended for documents of the highest possible permanence and durability.

Experience has shown that images written with Indian ink as well as printed images using commercial printing inks have a high degree of permanence. There are, however, many documents where acidic inks have affected the paper to such an extent that the paper has corroded, and images produced from dry or liquid toner are also susceptible to ageing problems.

The experience of modern images is limited to a few decades only. Images prepared with modern material and machinery are often completely different from old images with respect to composition and properties. Therefore, conclusions based on studies of old documents in libraries and archives are of limited use when discussing the permanence of modern documents.

Strictly speaking, the only way to test the permanence of the image is to handle the document and to store it under the relevant conditions for long periods of time, perhaps for several hundred years. In practice, one has to rely upon observations made on documents kept for a few years only, and on evaluation of the effect of factors known to influence the permanence and durability of the image.

Information and documentation — Permanence and durability of writing, printing and copying on paper — Requirements and test methods

1 Scope

This International Standard specifies requirements and test methods for evaluation of the permanence and durability of writing, printing and copying on paper stored in libraries, archives and other protected environments for long periods of time.

It is applicable to

— images on paper with the exception of documents within the scope of ISO/TC 42, *Photography*;

— multicoloured images.

The information contents of multicoloured images should be retained but not necessarily the full artistic quality of the coloured image. Documents where the information contents are influenced by small colour changes are not covered by this International Standard.

It does not apply to

— documents stored under harmful conditions, such as high humidity that may promote microbiological attack, excessive heat, radiation (e.g. light), high levels of pollutants, or the influence of water. Since documents may be kept in non-protected environments before being transferred to protected environments, resistance to water and light is, however, of importance;

— legal documentation, e.g. banking documents, where the authenticity is of primary interest.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 5-3:1995, *Photography — Density measurements — Part 3: Spectral conditions.*

ISO 1924-2:1994, *Paper and board — Determination of tensile properties — Part 2: Constant rate of elongation method.*

ISO 2470:—[1)], *Paper, board and pulps — Measurement of diffuse blue reflectance factor (ISO brightness).*

ISO 4892-2:1994, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc sources.*

ISO 5626:1993, *Paper — Determination of folding endurance.*

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[1] To be published. (Revision of ISO 2470:1977)

ISO 7724-1:—[2], *Paints and varnishes — Colorimetry — Part 1: Principles.*

ISO 7724-2:—[3], *Paints and varnishes — Colorimetry — Part 2: Colour measurement.*

ISO 7724-3:—[4], *Paints and varnishes — Colorimetry — Part 3: Calculation of colour differences by CIELAB.*

ISO 9352:1995, *Plastics — Determination of resistance to wear by abrasive wheels.*

ISO 9706:1994, *Information and documentation — Paper for documents — Requirements for permanence*

ISO 12757-1:1998*, Ball point pens and refills — Part 1: General use.*

ISO 12757-2:1998*, Ball point pens and refills — Part 2: Documentary use (DOC).*

ISO 14145-1:1998, *Roller ball pens and refills — Part 1: General use.*

ISO 14145-2:1998, *Roller ball pens and refills — Part 2: Documentary use (DOC).*

BS 3484:1991[5], *Specification for blue-black record inks.*

3 Definitions

For the purposes of this International Standard, the following definitions apply:

3.1
copying
production of an image on paper which is a reproduction of the image of another document carrier, e.g. by a photographic or xerographic process

3.2
document
recorded information which can be treated as a unit in a documentation process [ISO 5127-1:1983[6]]

3.3
durability
the ability to resist the effects of wear and tear in performance situations

3.4
image
pigments distributed on paper as characters or other visually identifiable patterns

3.5
monochromatic image
image with recording in one colour

3.6
multicoloured image
image composed of recording in more than one colour, where the colours constitute part of the information contents

3.7
permanence
the ability to remain chemically and physically stable over long periods of time

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[2] To be published. (Revision of ISO 7724-1:1984)

[3] To be published. (Revision of ISO 7724-2:1984)

[4] To be published. (Revision of ISO 7724-3:1984)

[5] Obtainable from British Standards Institution, 389 Chiswick High Road, GB-London W4 4AL.

[6] ISO 5127-1:1983, *Documentation and information — Vocabulary — Part 1: Basic concepts.*

3.8
permanent image
image which, during long-term storage in libraries, archives and other protected environments will undergo little or no change in properties that affects its use.

NOTE Examples of such properties are the stability of the created image (e.g. legibility and contrast) and the stability of the system of recording on paper.

3.9
printing
production of an image on paper from a printing device, such as a printing press, a thermal printer or a computer printer (e.g. a laser printer or ink jet printer)

3.10
recording
writing, printing and copying

3.11
spot-coloured image
image with different colours in separate parts, so that the colours are not superimposed

3.12
writing
production of an image on paper, one character or stroke at a time

EXAMPLES By hand with a pen or pencil or by means of a typewriter or pen plotter.

4 Required characteristics

Paper documents conforming to this International Standard shall meet the following requirements. Specimens for testing shall be prepared as described in clause 5**.**

4.1 Optical density

The optical reflection density of monochromatic images, determined as described in 6.1, shall meet the requirements in Table 1. These requirements are applicable also to spot-coloured images. No minimum values are set for multicoloured images.

4.2 Appearance

Each element of the image shall be clearly defined and easily legible when inspected as described in 6.2. The colour strength shall be even. Images prepared by stamp-pad inks shall be legible. No feathering or strike-through is acceptable.

4.3 Lightfastness

After illumination in accordance with 6.3, the optical density of monochromatic images shall meet the requirements of Table 1. These requirements are applicable also to spot-coloured images. The colour tone may change but it shall still be recognizable as being of the same colour as before treatment.

Multicoloured images shall meet the requirements of Table 2. Measurements shall be performed in accordance with ISO 7724.

4.4 Water resistance

After treatment with water[7)] in accordance with 6.4, the optical density of monochromatic images shall meet the requirements of Table 1. The colour tone may change but it shall still be recognizable as being of the same colour as before treatment. These requirements are applicable also to spot-coloured images.

Multicoloured images shall meet the requirements of Table 2. Measurements shall be performed in accordance with ISO 7724.

Only a slight discoloration of the paper, density change $\leqslant$ 0,05, is accepted. No visible defects on the image are acceptable when inspected as described in 6.2 (see. 4.2, first sentence).

4.5 Transfer of recording

Specimens kept in a stack under pressure as described in 6.5 shall show no evidence of blocking (sticking) or damage to the image. No characters, or parts of characters, shall be visible on the adjacent paper, but traces of transfer in the form of minute dots are acceptable.

Table 1 — Minimum optical densities (ISO visual density) of monochromatic images

Type of recording	Colour	Minimum optical density	
		Subclauses 4.1, 4.4 and 4.7	Subclause 4.3
Copying machines, laser printers, and other printing devices	black	0,90	0,80
	blue	0,65	0,55
	other colours	0,40	0,30
Other recording materials	black	0,50	0,40
	blue	0,40	0,35
	other colours	0,35	0,30

NOTE 1 The reasons for different minimum values for different types of recording are discussed in informative annex C.

NOTE 2 Use of commercial densitometers with filters that are not in agreement with ISO 5-3 is treated in 6.1 and further discussed in informative Annex C.

Table 2 — Maximum changes of multicoloured images

	ΔL^*	Δa^*	Δb^*
Subclause 4.3	± 8	± 5	± 5
Subclauses 4.4 and 4.7	± 5	± 3	± 3

NOTE ΔL^*, Δa^* and Δb^* are the colour differences.

7) Resistance to forgery by chemicals may be important for some types of documents, e.g. banking documents. ISO 12757-2 and ISO 14145-2 contain requirements on resistance to chemicals other than water.

4.6 Resistance to wear

When tested in accordance with 6.6, the image shall be at least equally resistant to wear as the lines drawn with the reference ink. This requirement is met when the ratio between the retention of the light absorption of the image and of the reference lines is $\geqslant 0{,}80$.

Flaking of part of the image causing partial deletions or voids shall not occur at the initial abrading specified in 6.6, step 4).

4.7 Resistance to heat

After having been kept in accordance with 6.7 for 12 days, the optical density of monochromatic images shall meet the requirements in Table 1. The colour tone may change but it shall still be recognizable as being of the same colour as before treatment. These requirements are also applicable to spot-coloured images.

Multicoloured images shall meet the requirements of Table 2. Measurements shall be performed in accordance with ISO 7724.

The image shall also meet the requirements of 4.2 and 4.5.

4.8 Effects of recording on the mechanical strength of the paper

Paper may be affected by the recording process and by the resulting image. Heat, radiation and chemical agents involved in the processing may cause degradation of the paper.

For paper documents prepared by recording that involves processing of any kind, the requirements of 4.8.1 and 4.8.2 shall be met in any direction (machine and cross) of the paper. For paper documents prepared by recording where no processing occurs, the requirements of 4.8.1 shall be met in any direction (machine and cross) of the paper. In the case of, for example, ball-point pens, where specimens in accordance with 6.8.1 are normally obtainable in one direction only, testing in one direction is accepted.

4.8.1 Tensile energy absorption

The tensile energy absorption of strips with images shall not be lowered by more than 10 % compared to strips of the performance testing paper, when tested as described in 6.8.1.

4.8.2 Folding endurance

The folding endurance of strips with images shall not be lowered by more than 0,1 compared to strips of the performance testing paper, when tested as described in 6.8.2.

5 Preparation of test specimens

5.1 Performance testing paper

Paper used for test specimens shall meet the requirements of normative annex A.

5.2 Recording atmosphere

Preferably, material (including paper) should be conditioned for at least 15 h at (23 ± 2) °C and (50 ± 5) % RH before recording. The recording should be performed in the same atmosphere.

If this is not possible, instructions from the manufacturer of the material to be tested or machinery to be used for testing shall be followed.

5.3 Specifications for test specimen preparation

Specimens for testing purposes shall be prepared as described in an International Standard dealing with the specific type of material or machinery. If no such standard is available, the preparation of test specimens shall be performed according to the instructions of the manufacturer of the material or machinery.

Characters, spacing, etc. shall represent normal use of the material.

Further specifications are given in normative annex B.

5.4 Reference ink

The reference ink shall be prepared in accordance with BS 3484-1:1991, annex A. This reference ink is used as an internal standard when testing resistance to wear in accordance with 6.6.

NOTE It may also be used when testing feathering as described in normative annex A.

5.5 Conditioning of specimens

Prior to testing in accordance with 6.4, 6.5 and 6.6, specimens shall be kept (in a hanging position) at (23 ± 2) °C and (50 ± 5) % RH for at least one week. When testing the paper strength (see 6.8), the conditioning and testing atmosphere shall be in accordance with ISO 1924-2 and ISO 5626.

6 Testing

6.1 Optical density

Prepare the recording so that measurements can be performed on lines or characters with no overlapping, e.g. crossed lines.

Determine the optical density as ISO visual density, $D_R(S_A{:}V)$, in accordance with ISO 5-3 (see informative annex C for further information).

Other measuring devices, or visual comparison with reference sheets, are acceptable if the same accuracy can be ascertained. If such devices or methods are used, this shall be recorded in the test report [see clause 7, letter i)],

— stating how the measurement was done, and

— giving an evaluation of how this deviation has influenced the results of the measurements.

Visual comparison with reference sheets of images where the line (character, dot, etc.) being measured does not cover the paper completely, e.g. lines from ball-point pens and roller-ball pens, tends to give a higher estimate of colour strength than measurement with a densitometer. The reported value shall be the average optical density of the line.

NOTE Densitometers for determination of optical density should have a measuring area smaller than the area to be measured. If such a densitometer is not used, care should be taken to ensure that the alternate method gives the same results as that type of densitometer.

6.2 Appearance

Inspect visually, at magnification 8 × using a magnifying glass or an equivalent device, for defects such as voids or broken characters, bad edge definition, uneven colour, and other defects.

6.3 Lightfastness

Illuminate with a xenon-arc in accordance with method B of ISO 4892-2. The black panel temperature shall be (60 ± 3) °C and the humidity shall be (50 ± 5) % RH.

Expose the specimens to 12 kJ/cm^2. Determine the optical density of the image as specified in 6.1 before and after illumination.

6.4 Water resistance

Prepare specimens with approximately 10 % image coverage. Leave an area at the centre of the specimen free from image and use this area for determination of the optical density of the background.

Completely immerse the specimens in glass tubes with deionized water for 24 h, with one tube for each specimen. Lift the specimens carefully onto acid-free tissue paper. Place a piece of the performance testing paper on the specimens and load with a pressure of 7 kPa. Remove the load after 10 min. Leave the specimens on tissue paper and let them dry.

Inspect the specimens visually as described in 6.2. Determine the optical density of the image and of the paper background as specified in 6.1 before and after immersion.

6.5 Transfer of recording

Prepare five specimens and six pieces of performance testing paper and condition them at (23 ± 2) °C and (50 ± 5) % RH. For paper documents prepared by recording that involves processing of any kind, both one-and two-sided documents shall be tested when applicable. Place them in a stack in alternate order, performance testing paper, specimen, performance testing paper and so on, on a flat plate of an inert material. Cover the stack with another plate of inert material and load with a pressure of 7 kPa. Store at (50 ± 1) °C and (60 ± 2) % RH for 6 days. Remove the load and allow to cool at 23 °C and 50 % RH for at least 15 h before separating the specimens.

Inspect the image and the adjacent performance testing papers visually.

6.6 Resistance to wear

Draw three lines of approximately 0,3 mm width with reference ink (see 5.4) close to the image as shown in Figure 1. For paper documents prepared by recording that involves processing of any kind, both one- and two-sided documents shall be tested when applicable.

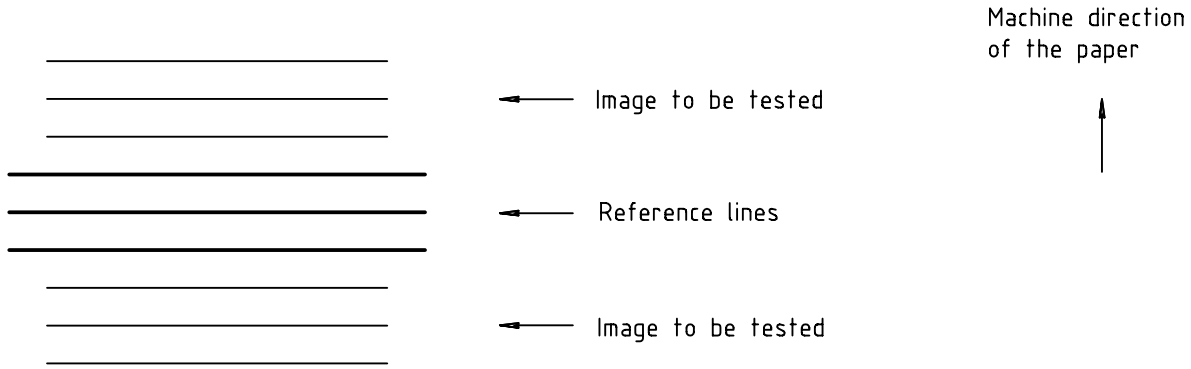

Figure 1 — Examples of test specimen with reference ink lines for testing of resistance to wear

Follow the following four steps before inspection.

1) Determine the light absorption of the image and of the reference lines on the specimen area to be tested (see notes 1 and 2 below).

2) Abrade the image and the reference lines simultaneously with a testing machine in accordance with ISO 9352, using wheels with Series designation CS 10F and load 2,5 N. Abrade until the light absorption of the reference ink lines has been reduced to between 80 % and 85 % of the initial value. Determine the light absorption of the image and the reference lines as described in step 1).

3) Calculate the resistance to wear as

$$\frac{A_{i2} / A_{i1}}{A_{r2} / A_{r1}}$$

where

A_{i1} is the initial light absorption of the image;

A_{i2} is the absorption of the image after abrasion;

A_{r1} is the initial light absorption of the reference lines;

A_{r2} is the light absorption of the reference lines after abrasion.

NOTE 1 Since no absolute values are needed, and the test does not influence the colour spectrum of the image, different instruments may be used for the determination of the light absorption of the image. Optical densitometers according to ISO 5 need not be used.

NOTE 2 Resistance to wear may be evaluated by visual comparison of the abraded area with the unaffected part of the sample.

NOTE 3 The light absorption may be calculated from the optical density D measured in accordance with 6.1 as $1–10^{-D}$.

4) Perform a new test and inspect the image after abrading approximately 25 % of the total number of the abrasions described in step 2). If no flaking (see 4.6) is observed after abrasion in accordance with step 2), this test need not be performed.

Inspect the test specimens visually. Note partial deletions and voids.

6.7 Resistance to heat

Suspend the test pieces in a climate chamber or ageing vessel in such a way that they do not contact each other or the sides of the chamber. Pass air at a rate of (50 ± 25) ml/min through the chamber. Keep specimens and performance testing papers at (90 ± 1) °C and (50 ± 2) % RH for 12 days. Test the specimens in accordance with 4.7.

6.8 Effects of recording on the mechanical strength of the paper

6.8.1 Tensile energy absorption

Record five lines across ten sheets of the performance testing paper, for five of the papers in the machine-direction and for five of the papers in the cross-direction. Cut strips according to ISO 1924-2 for determination of tensile properties in such a way that the lines are perpendicular to the length of the strips. The lines shall be placed across the middle of the strips and extend to the edges. Cut strips from performance testing papers from the same paper pack.

Keep strips of paper with and without images for 12 days as specified in 6.7. Determine the tensile energy absorption in accordance with ISO 1924-2 in the machine- and the cross-directions of the paper.

NOTE 1 In the case of, for example, pin writers, rows of contiguous dots are recorded.

NOTE 2 If the paper is affected by the image, the strips will break at the lines.

6.8.2 Folding endurance

Prepare ten paper specimens with images for performance testing. Cut strips in the machine- and cross-directions of the papers according to ISO 5626 for testing of folding endurance. Cut strips from performance testing papers from the same paper pack.

Store strips of paper with and without images as specified in 6.7. Determine the folding endurance according to ISO 5626 in the machine- and cross-directions of the paper.

NOTE 1 Since this subclause describes a test for evaluation of the influence of the recording process on the paper, and not of the influence of the recorded image on the paper, lines (characters, dots, etc.) should not be positioned at the site of the fold.

NOTE 2 For the purposes of this International Standard, any one of the four instruments described in ISO 5626 may be used. The requirement remains the same for all of the instruments.

7 Test report

The testing laboratory shall include the following information in its report:

a) a reference to this International Standard;

b) precise identification of the material tested (including paper) and machinery used in testing, and, when applicable, accessories and processing data;

c) date and place of testing;

d) type of writing, printing or copying material or machinery;

e) number of test pieces used in the test;

f) description of specimen preparation;

g) the test results obtained when testing as specified in 6.1 to 6.8, expressed as stated in the relevant subclause, or in the relevant International Standard referred to;

h) any other observations made that may be of importance for the permanence of paper documents;

i) any deviations from this International Standard and any circumstances that may have affected the results;

j) a statement that the material or machinery meets or fails to meet the requirements of this International Standard; in the latter case the specific reason shall be stated.

Annex A
(normative)

Performance testing paper

A.1 Choice of paper

The choice of paper for preparation of specimens to be tested is very important since some properties of the image differ between different papers. Results when testing paper documents prepared by a particular imaging process on one type of paper may not be valid for other papers.

The same type of paper is not used all over the world. Paper properties such as surface smoothness, grammage and sizing, may vary considerably. In some countries, the same type of paper is used for writing, printing and copying, in others, the difference between so called photo-copying paper and writing and printing paper is substantial.

These requirements shall not be considered as recommendations to manufacturers and users of paper. Their only purpose is to make the test results representative of papers on the market and to make it possible to obtain reproducible results when testing at different laboratories.

A.2 Specifications for performance testing papers

Performance testing paper for use in the preparation of test specimens shall be suitable for use with the type of material or machinery to be tested.

All performance testing papers shall meet the following requirements:

— the paper shall meet the requirements in ISO 9706;

— the ISO-brightness, measured in accordance with ISO 2470, shall be $\geqslant$ 85 %;

— when testing the wear resistance in accordance with this International Standard, no visually perceptible fibre loss shall occur;

— crossed lines, drawn with the reference ink at approximately 50 mm/s, shall show no feathering or strike-through;

— the grammage shall not be less than 70 g/m^2.

The folding endurance should be at least 1,7 (Köhler-Molin, MIT, or Lhomargy testers) or 1,9 (Schopper testers) in any direction. The intention of this recommendation is to provide for adequate accuracy when testing the effects of recording on the mechanical strength of the paper.

NOTE A folding endurance of 1,7 corresponds to a fold number of 50. A folding endurance of 1,9 corresponds to a fold number of 80. It should be observed that the folding endurance is the mean of the logarithms (to the base 10) of each of the individual readings.

Performance testing paper to be used with ball pens shall, in addition, meet the roughness/smoothness requirement of ISO 12757 when testing images made by ball-point pens, and that of ISO 14145 when testing images made by roller-ball pens.

Annex B
(normative)

Test specimen preparation

B.1 General

The method of specimen preparation and the appearance of the image are of great importance when testing many properties. In this International Standard, reference is made to other standards or to instructions from the manufacturer. Some further specifications are necessary in order to obtain reproducible results and to get a relationship to the requirements given in this International Standard.

B.2 Ribbons for typewriters, matrix printers, etc.

At present, no standardized procedure for specimen preparation is available. The following provisions shall be taken into account.

— Recording with a fabric ribbon shall be performed with equipment for which the ribbon is intended.

— The properties of images prepared with other ribbons in equipment with different printing pressures, rolls of different hardnesses, etc., may differ considerably. In order to obtain representative results, recording with such a ribbon shall be performed with the type of equipment in which the ribbon will be used.

— The equipment shall be in good condition (e.g. clean, no aged rolls).

— The equipment shall be adjusted for normal writing.

— The writing pressure shall not be so high as to cause the reverse side of the paper to feel uneven when touched with the finger tip.

Recording with fabric ribbons and similar ribbons shall be performed so as to represent ribbons which have been in use.

B.3 Ball-point pens, roller-ball pens, porous-tip pens, etc.

Generate lines by a write test machine set according to the conditions specified in ISO 12757 for ball-point pens and ISO 14145 for roller-ball pens.

For other pens, generate lines in accordance with the instructions of the manufacturer.

Annex C
(informative)

Optical density measurement

C.1 Spectral conditions for measurement of optical density

In the early days of densitometry, the spectral response of instruments was specified only in terms of the colour filters used in the construction. In ISO 5-3:1995, Introduction, the advantages of specifying the product of all relevant components are emphasized.

ISO 5-3 defines the spectral conditions for measurement of optical density. Nine types of densities are specified. For the purpose of this International Standard, density is measured as ”ISO visual density”, see 6.1. The spectral products for this type of density are specified in ISO 5-3:1995, Table 2. Values obtained from instruments with other spectral characteristics cannot be transferred to ISO visual densities by any simple calculation.

There are a number of filters with different spectral characteristics on the market. Some of them are not in agreement with the specifications in ISO 5-3.

Two instruments for measurement of optical density are described in the American Standard ASTM F 1443-1992. The Clearwave Optical Character Tester (082) shall be equipped with the ”visual neutral” filter (no further specification is given in the standard). The filter specified for the Macbeth Print Contrast Meter (PCM II) is Standard Response ”A”. This filter is not in agreement with the specification of ISO visual density in ISO 5-3.

The illuminant is specified in ISO 5-3 as CIE standard illuminant A operating at a distribution temperature of 2856 °K. The distribution temperature of equipment on the market may differ slightly from this value.

C.2 Minimum values of optical density

Preferably, the contrast between the image and the paper background shall be as high as possible when microfilming or scanning a document. The minimum values of optical densities in Table 1 of this International Standard for images produced by copying machines, etc. are desirable but cannot normally be met by other types of images.

The difference in requirements for the various types of images is partly due to differences in the preparation of images to be tested. Lines prepared by copying machines, laser printers and ink jet normally cover the paper to a high extent. Thinner lines often cover the paper incompletely and the optical density becomes lower.

Ball-point pens and roller-ball pens normally generate lines with low optical densities, which results in low contrast. Since there is, however, a need for materials for handwriting, one has to accept such low densities. Difficulties when microfilming or scanning documents containing parts with different optical densities may occur, but can often be overcome by consideration of that part of the image that has the lowest contrast.

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