INTERNATIONAL STANDARD

ISO 3334

Second edition
1989-11-15

Micrographics — ISO resolution test chart No. 2 — Description and use

Micrographie — Mire de résolution ISO nº 2 — Description et utilisation

Reference number
ISO 3334 : 1989 (E)

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 approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 3334 was prepared by Technical Committee ISO/TC 171, *Micrographics and optical memories for document and image recording, storage and use.*

This second edition cancels and replaces the first edition (ISO 3334 : 1976), of which it constitutes a minor revision.

Annex A of this International Standard is for information only.

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Introduction

Micrographic systems vary in their ability to record fine detail such as alphanumeric characters or closely spaced lines. The method specified in this International Standard involves the measurement of the ability of a given objective, photosensitive material and processing combination to reproduce the image of fine detail and therefore can be applied to define and control this aspect of imaging quality.

Since microrecording systems can be operated close to limits of legibility, resolution testing provides a safeguard against the loss of information, although other factors also contribute to the overall quality of the micro-image.

ISO 3334 describes a method of testing resolution that employs the ISO resolution test chart No. 2, in which the test patterns and their arrangement are shown in figures 1 and 2.

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Micrographics — ISO resolution test chart No. 2 — Description and use

1 Scope

This International Standard specifies a method of determining resolution by measuring the minimum size of detail recognizable in a processed microform. It describes the test patterns and ISO resolution test chart No. 2, and gives the method of expressing resolving power. ISO resolution test chart No. 2 is designed for use as part of a test target, as required in other International Standards for micrographics.

This International Standard applies to the determination of the resolving power of a camera, film and processing combination used in a microfilming system or the resolution achieved in microforms therefrom. In this form it does not apply to the determination of the resolving power of microform readers, reader-printers or computer output microform (COM) imaging systems.

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 indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 3: 1973, *Preferred numbers — Series of preferred numbers.*

ISO 5-1 : 1984, *Photography — Density measurements — Part 1: Terms, symbols and notations.*

ISO 5-3 : 1984, *Photography — Density measurements — Part 3: Spectral conditions.*

ISO 5-4 : 1983, *Photography — Density measurements — Part 4: Geometric conditions for reflection density.*

ISO 2471 : 1977, *Paper and board — Determination of opacity (paper backing) — Diffuse reflectance method.*

ISO 6196-1 : 1980, *Micrographics — Vocabulary — Section 01: General terms.*

ISO 6196-2 : 1982, *Micrographics — Vocabulary — Section 02: Image positions and methods of recording.*

ISO 6196-3 : 1983, *Micrographics — Vocabulary — Part 03: Film processing.*

ISO 6196-4 : 1987, *Micrographics — Vocabulary — Part 04: Materials and packaging.*

ISO 6196-5 : 1987, *Micrographics — Vocabulary — Part 05: Quality of images, legibility, inspection.*

ISO 6196-6 : —[1], *Micrographics — Vocabulary — Part 06: Equipment.*

3 Definitions

For the purpose of this International Standard, the terms and definitions contained in ISO 6196 apply.

4 Description of the test chart

4.1 Base

The test chart shall be made on either an opaque or a transparent base.

4.1.1 Opaque base

The test chart shall be made on a white opaque base with a glossy surface. Its visual diffuse reflection density, measured as specified in ISO 5-3 and ISO 5-4, shall be not more than 0,08. The opacity, measured as specified in ISO 2471, shall be over 85 %. This test chart is positive-appearing.

1) To be published.

4.1.2 Transparent base

The test chart shall be made on a non-coloured transparent base having a maximum visual diffuse transmission density, base + fog, of 0,08, measured as specified in ISO 5-2 and ISO 5-3. This test chart can be positive-appearing or negative-appearing.

4.2 Test pattern

The test pattern shall consist of a numbered group of two sets of five parallel lines at right angles as shown in figure 1. The lines and spaces between them shall be of equal width. The visual reflection density of the lines shall be not less than 1,60 and of the spaces not more than 0,02 when measured relative to the white of the paper on which the chart is printed. A suggested level of quality for the appearance of the lines and space is discussed in annex A.

For a test chart on a film base, the minimum density difference between the base and the characters shall be 3,0.

To measure the widths of lines and spaces for conformance to values given in table 1, a precision microscope equipped with a micrometer, an optical comparator, or a computer-controlled co-ordinate measuring machine shall be used. These instruments shall be calibrated and capable of measuring to 1 µm or smaller.

4.3 Spatial frequency of test patterns

The dimensions of the range of test patterns used in the test chart shall be as specified in table 1, in which the sequence of steps, starting at 1.0, is in accordance with the R 20 series of preferred numbers given in ISO 3, with a first rounding except for the 1.25 and 12.5 patterns. Rounding of these numbers would have varied the spatial frequency sequence by too large a percentage. This gives an average increment of 12,2 % per step. The sequence thus obtained is shown in table 1. Measurement for the tolerances shown shall be made after the test chart has been maintained at a temperature of 23 °C ± 2 °C and a relative humidity of 50 % ± 5 % for a period of at least 1 h.

4.4 Method of numbering test patterns

The number that designates a test pattern shall be its spatial frequency expressed in line pairs per millimetre. For example, in the pattern designated 2.0, each line is 0,25 mm wide so that a line pair of one line and one space is 0,5 mm wide, therefore the pattern's spatial frequency is 2 line pairs/mm.

4.5 Test pattern number

The number of each test pattern shall be placed within the top right-hand quarter of the rectangle formed by the pattern. The size of the number shall be as shown in figure 1. The typeface used shall be "futura" medium or other sans serif typeface suitable for photographic reproduction.

4.6 Arrangement of test patterns

The test patterns shall be arranged on the test chart in order of increasing spatial frequency as shown in figure 2.

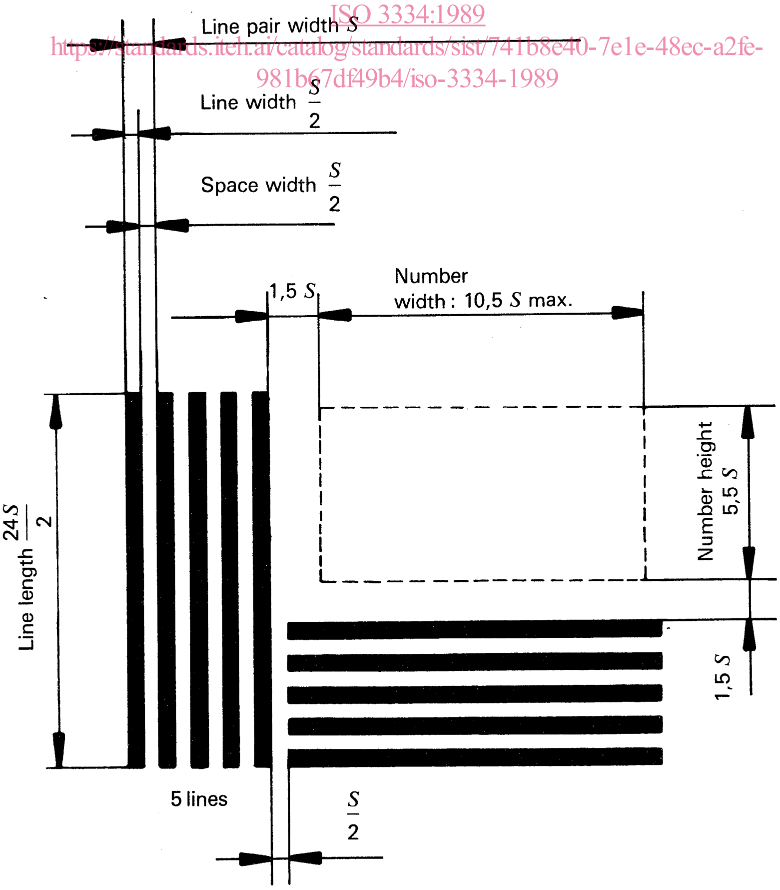

Figure 1 — Resolution test pattern

Table 1 — Dimensions and tolerances of the test patterns

Dimensions in millimetres

Test pattern spatial frequencies	1,0 1,1 1,25 1,4 1,6 1,8 2,0 2,2 2,5 2,8 3,2 3,6 4,0 4,5 5,0 5,6 6,3 7,1 8,0 9,0 10 11 12,5 14 16 18
Tolerance on spatial frequency	The length of four full cycles shall be within ± 3 % of the nominal length of four cycles
Tolerance on $\frac{\text{line length}}{\text{line width}}$	22,8 to 25,2
Tolerance on $\frac{\text{line width}}{\text{space width}}$	1 to 10 line pairs/mm incl. : 0,95 to 1,05 11 to 18 line pairs/mm incl. : 0,9 to 1,1

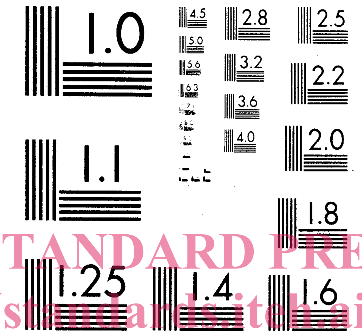

Illustration not to be used for testing

Figure 2 — Arrangement of test patterns in ISO resolution test chart No. 2 (actual size)

4.7 Test chart title and source

The words "ISO resolution test chart No. 2" and the certifying agent[1)] or the source of issue shall appear on the test chart below the test patterns.

5 Procedure for using the test chart

The test chart shall be reproduced on the microform with the camera/film system as specified in the appropriate International Standards.

6 Procedure for reading images of test charts

6.1 Microscope

Use a microscope having a good quality achromatic objective. Its magnification shall be between 1/3 and 1 times the expected system's resolving power when the microform is examined. For example, to view an image produced by a system with a resolving power of 150 line pairs/mm, the magnification shall be between × 50 and × 150.

6.2 Examination of test pattern

Examine the test patterns (4.2) on the test chart with the microscope (6.1) and note the smallest pattern that can be resolved, that is the pattern in which all five individual lines can be distinguished in both directions. For example, in figure 3, the smallest pattern in which all lines can be distinguished is the pattern numbered 5.6.

6.3 Spurious resolution

If spurious resolution occurs, that is, if some of the patterns that are unresolved are larger than some of the smaller patterns that appear to be resolved but in which there are only 4 lines out of 5 distinguished, note the number of the pattern that is next to and larger than the first one unresolved. Spurious resolution is most commonly caused by the camera being slightly out of focus.

1) Currently, test charts certified to conform to this International Standard can be obtained from the National Institute of Standards and Technology, Office of Standard Reference Materials, Gaithersburg, MD 20899, USA.

6.4 Lines in one direction unresolved

If the lines in one direction appear resolved while those at right angles do not, it is possible that the eyesight of the examiner is astigmatic. To check for this possibility, the pattern is viewed at 90° to the original direction. If the same set of lines remains unresolved, the fault lies in the film sample or in the camera and not in the examiner.

6.5 Expression of resolving power

To express the resolving power of the camera, film and development combination in line pairs per millimetre, multiply the number of the smallest pattern resolved by the inverse of the reduction ratio at which the target was filmed. For example, if the smallest pattern resolved is numbered 5.0 and the reduction ratio is 1/24 the resolving power is 120 line pairs/mm.

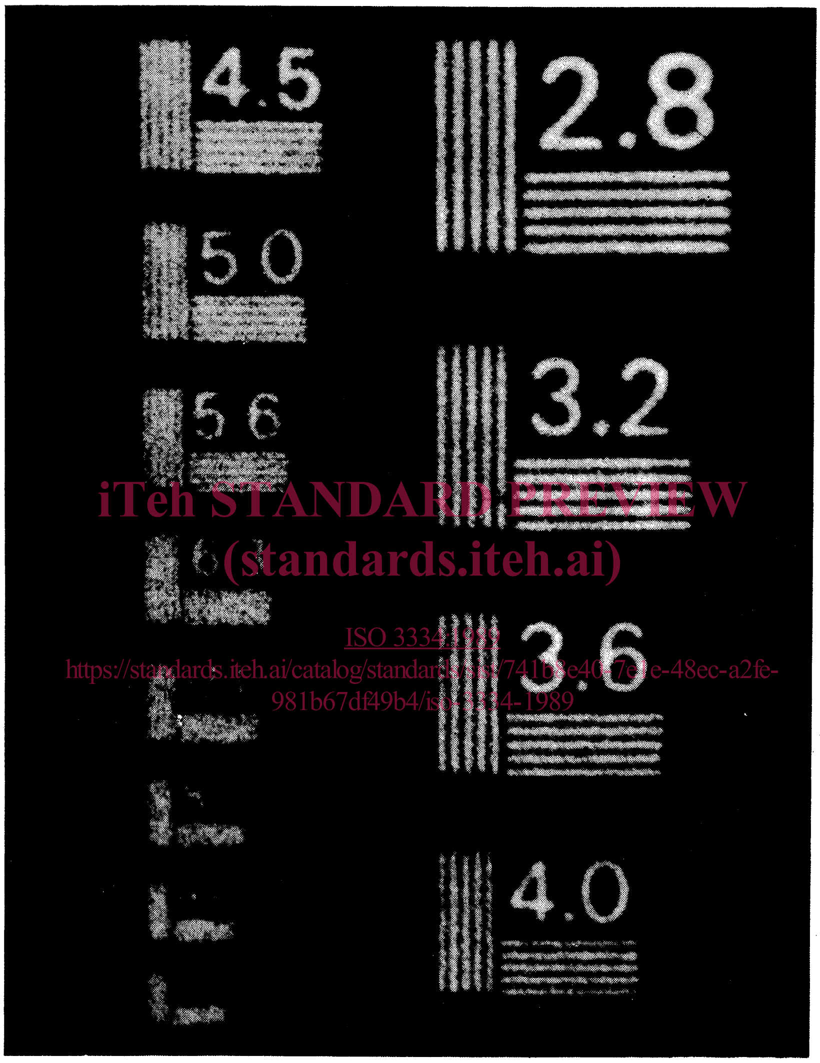

Figure 3 — Reproduction of photomicrograph of test patterns on a typical microform
(In the illustration the pattern designated 5.6 is considered the smallest pattern resolved)

Annex A
(informative)

Defects

During manufacture of the test chart, defects can occur in the images of the lines and spaces. The size of the defect relative to the width of the line or space will determine the degree to which the defect will influence the measurement of the resolving power of a microfilming system. The following description of defects is suggested as guidelines for the rejection of test charts:

1. Corners not square and edges broken or uneven with the remainder of the line and space.

2. Holes or marks in the line or space area that are larger than one-half of the width of a line or space.

3. Breaks,cuts, or marks that are completely through or over one-half the width of the line or space.

4. Cuts or marks along the edges or in the line or space with length greater than one-fourth the length of the line or space.

The main causes of rejection in the test charts are shown in figure A.1. Notation of printing flaws are for both vertical and horizontal line, space patterns.

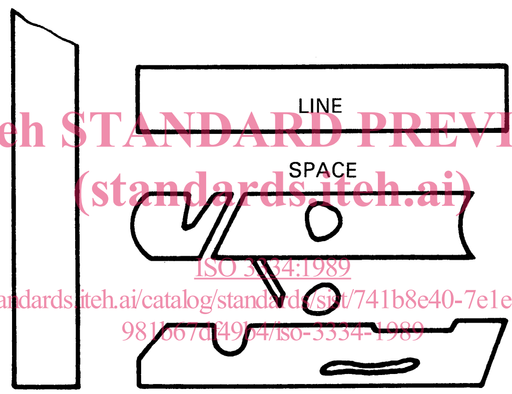

Figure A.1 — Example of defects