INTERNATIONAL STANDARD

ISO/IEC 13660

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Information technology — Office equipment — Measurement of image quality attributes for hardcopy output — Binary monochrome text and graphic images

Technologies de l'information — Équipement de bureau — Mesurage des attributs de qualité d'image pour copies papier — Texte monochrome binaire et images graphiques

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 13660 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 28, *Office equipment*.

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

Introduction

This International Standard is designed to help a quality control engineer evaluate the quality of prints from office imaging systems.

In traditional imaging systems (such as ink-on-paper printing), an image is evaluated by comparison to an original or master version of that image. In many electronic imaging systems, however, the image is created digitally within the system. There is no hardcopy master and so there can be no evaluation by comparison in the ordinary way.

Often, those who operate electronic imaging systems ensure good image quality by controlling the imaging process. They use test targets and reference images to evaluate the performance of the system.

If it is not possible to control image quality by controlling the imaging process and if no test target or reference image is available, we can rely only on direct evaluation of properties of the image itself.

To perform intrinsic evaluations of image quality, we must consider the nature of an image that is output. An image is some organization of information in space. We assume that these signals have some purpose or are making some attempt at communication. Good image quality means that the image is legible (the organization and information can be interpreted) and that it has a pleasing appearance.

Our goals in developing this International Standard were to compile a list of image attributes that (taken together) correlate to human perception of print quality and to develop measurement methods for these attributes that can be automated and carried out on a simple system.

Legibility and appearance have several aspects:

- Detail can be detected easily.
- Image elements are well isolated from the background.
- The image has a minimum of gross defects.
- The imaging system has good geometric fidelity.

Not all these factors can be covered by evaluation of intrinsic, quantitative image quality attributes. Many of them have a large psychological or cultural component that is difficult to evaluate.

A print made with large optical reduction or one that is out of focus might still have excellent edge quality (and be totally lacking in gross defects, banding, noise, etc.) and yet be illegible. This could occur primarily because of the high process gamma (contrast) that is characteristic of many xerographic processes. Thus, the process can produce apparently sharp edges in spite of the loss in resolution. Without a resolution target of some kind, the extent of the resolution loss, and hence legibility, may not be known.

The purpose of this International Standard is to present a set of objective, measurable attributes that give some correlation to the perceived quality of an image to a human observer at a standard viewing distance. The standard will allow a user of printed material to sort samples into several groups, from excellent to bad.

The attributes and methods for their assessment are based on several assumptions:

- The image represents an attempt at communication.
- There is uniformity within identifiable image elements.

- Character images, symbols, and graphic elements are regular (that is, they are intended to be identical when they have multiple, similar occurrences).
- Samples with extreme gross defects have been screened out.

This International Standard applies to images made up of text, graphics, and other image objects with two-tone levels of a single colour (typically black image on white paper). This International Standard does not cover halftones or images with more nominal gray levels, continuous tone images, colour images, and so on.

Image quality measurement can be thought of as divided into diagnostic (high resolution), and visual scale (low resolution) procedures. Diagnostic measurements typically use precision test targets and instrumentation and are key to much engineering work. The present procedure, by contrast, is limited to phenomena visible to the naked eye and does not permit test patterns.

The working group has taken the approach of selecting simple and (in our judgment) effective metrics, rather than attempting to prove that our method of doing a given job will always be the most exact.

How will this International Standard actually be implemented? A complete evaluation system has three components: an image capture device, evaluation software, and application-specific quality standards and sampling plan. The end user may choose to develop all these parts himself or he may choose to purchase one or more components from a commercial supplier.

Any equipment capable of gathering data appropriate to these measurements is understood to have a complex instrument function. Rather than attempting to explore the relationship among these instrument functions, the working group has defined reference images, and target values for them. If these target values are achieved by an instrument, calibration will be acceptably good.

This is not an attempt to break new ground in image science. It is an attempt to provide suppliers and customers for copies/prints with a practical and objective way to communicate about basic image quality parameters.

Information technology — Office equipment — Measurement of image quality attributes for hardcopy output — Binary monochrome text and graphic images

1 Scope

This International Standard specifies device-independent image quality attributes, measurement methods, and analytical procedures to describe the quality of output images from hardcopy devices. This International Standard is applicable to human-readable documents composed of binary monochrome images produced from impact printers, non-impact printers, and copiers.

The attributes, methods, and procedures rely on intrinsic properties of the image. Targets or reference images are not required. The International Standard is not applicable to images on media other than hardcopy (e.g. images on a VDT) or to images that are intended to be machine readable only (e.g. bar codes).

This International Standard is not intended to apply to pictorial art. It is optimized for black colourant forming the image on a white substrate; it is not intended to be used for dropped out or reversed type or for transparencies. The evaluation of an image with any other colour of colourant or substrate will be sensitive to changes in illumination. In this case, the procedures of this International Standard may not be applicable and should be used with caution.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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

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

ISO 5-4:1995, *Photography — Density measurements — Part 4: Geometric conditions for reflection density*

CIE 15.2:1986, *Colorimetry*

TAPPI T480 om-92, *Specular gloss of paper and paperboard at 75 degrees*

TAPPI T452 om-92, *Brightness of pulp, paper, and paperboard (directional reflectance at 457 nm)*

3 Terms and definitions

For the purposes of this International Standard, the following terms and definitions apply. The image quality attributes themselves are defined in Clause 5.

binary— any system based on exactly two possible values, such as 0/1 or black/white.

binary image— an image with only two fundamental tones: the substrate and the colourant.

boundary— the region of an edge within which the reflectance factor makes the transition from 10% to 90% of the difference between image and substrate reflectance factors. See also *threshold contour.*

character image— a specific physical representation of a character glyph.

colourant— the material used to make an image visible. In copying and electronic printing, the two main colourants are dye and pigment.

density, optical— log10 (1/*R*), where *R* is the reflectance factor, measured according with 0/45-degree geometry, Illuminant A, and ISO visual density calibration.

distortion— undesired change in the shape of an image.

edge threshold— the points in the gradients of an edge that define the location of the edge. This is the threshold contour corresponding to R_{60} for the ROI. See also *threshold contour.*

gradient, edge— the relative reflectance value gradient along a line normal to the edge of an image segment.

hardcopy— a document on a substrate.

human-readable— designed to be interpreted by a standard human viewer.

image element— a single, evidently intentional, object not connected to other objects.

image segment— a collection of image elements that are treated as a unit.

inner boundary edge— the point in the gradient of an edge that is at 90% of the transition from the substrate reflectance factor to the image reflectance factor: $R_{90} = R_{max}–90\%(R_{max} – R_{min})$.

line width— width of the line measured normal to the line from edge threshold to edge threshold.

monochrome image— an image in one colour or shades of one hue.

nominal— a value used as a reference value. This value is obtained by assumption, by calculation, or by some other means and then treated as the actual, intended value.

normal edge profile— the reflectance factor gradient along a line normal to the edge of an image segment.

outer boundary edge— the point in the gradient of an edge that is at 10% of the transition from the substrate reflectance factor to the image reflectance factor: $R_{10} = R_{max}–10\%(R_{max} – R_{min})$.

page— a collection of text, graphics, and other image objects intended to be printed on one side of a sheet of hardcopy.

pixel— a contraction of the term “picture element”; the smallest geometric unit of information in a digital representation of an image.

pseudorandom— a sequence which is generated by a predictable process, but which has all the measurable properties of a truly random sequence that are required for a particular application.

random— a sequence that is generated by a process in which each element is unrelated to the preceding element, which has no pattern, and which is completely unpredictable.

reflectance factor— the ratio of radiant flux reflected from the sample to the radiant flux incident on the sample.

relative reflectance value— percentage of the transition from the substrate reflectance factor to the image reflectance factor at a particular point in the image.

region of interest (ROI)— area (inside defined boundaries) that the user wants to analyse.

$\boldsymbol{R}_{\mathbf{max}}$— maximum reflectance factor in the ROI, typically of the substrate. This is taken to be the centre of the higher peak in the bimodal reflectance distribution across the ROI.

$\boldsymbol{R}_{\mathbf{min}}$— minimum reflectance factor in the ROI, typically of the colourant. This is taken to be the centre of the lower peak in the bimodal reflectance distribution across the ROI.

ROI— see *region of interest.*

sharpness, edge— the inverse of blurriness. (See 5.3.1.)

spi (spots or samples per inch)— spots or samples per 25,4 millimetres.

standard viewing distance— 300 millimetres, assuming standard visual acuity.

substrate— the material on which a hardcopy document is produced, usually paper.

threshold contour— the points in the gradients of an edge that are at some specified percentage of the transition from the substrate reflectance factor to the image reflectance factor: $R_p = R_{\text{max}} – p\%(R_{\text{max}} – R_{\text{min}})$.

tile— a plane figure used for a tiling.

tiling, regular— to cover the plane (or region of the plane) with identical plane figures so that there are no gaps and there is no overlap of the figures.

4 Report of results and sampling scheme

This clause contains the three possible image sampling schemes (4.3) and a description of the report of an evaluation carried out under this International Standard (4.1).

4.1 Report of results

4.1.1 Test identification information

The report shall include the date of the measurements, the identity of the test operator, lot identifications, etc.

4.1.2 Instrument system

The report shall include a description of the instrument system used, noting any of the specifications (see Clause 6) that are emulated or deviated from in any way.

4.1.3 Compliance

Report the results of the compliance tests. (See Clause 6 and Annex B.)

4.1.4 Sampling scheme

The report shall include a complete description of the sampling scheme (4.3) used to select the pages and images.

4.1.5 Results

For each attribute, the report shall include the number of samples per page and the mean, standard deviation, and range of the results for each page and for the entire lot.

ORIGINATOR Test Description Date of Report Test Operator	XYZ Printing Company Results of Oct. 17, 1996 print set December 6, 1996 RJC
INSTRUMENTATION Type Measurement and analysis software	XYZ Optical Company, Model XXX 600 spi flatbed scanner IMAGE ANALYZER by ABC Inc.
COMPLIANCE TESTS Density Measurements Spatial Measurements Line Attributes Measurements Graininess & Mottle Measurements SAMPLING SCHEME	 within the tolerance within the tolerance within the tolerance within the tolerance Random Sampling
LARGE AREA DENSITY ATTRIBUTES darkness, large area background haze graininess mottle extraneous marks, background void CHARACTER AND LINE ATTRIBUTES blurriness raggedness line width darkness, character contrast fill extraneous marks, character field background haze, character field	# of samples/page Mean STD # of samples/page Mean STD

Figure 1 — Sample report of an evaluation

4.2 Sampling of pages

The pages chosen shall be taken from a homogeneous lot. They shall all (as far as can be determined) be on the same substrate, produced with the same process, and be of the same age.

The number of pages to be sampled depends on the user's optimal balance between risk and cost and on the uniformity of the process that produced the lot.

Any sampling scheme selected shall allow for the presence of pages with defects beyond the scope of this International Standard (such as physical damage to pages) and pages with defects which would be unacceptable to practically all observers. These pages should be evaluated separately.

4.3 Sampling of images

Three sampling schemes and the information required to specify them in the report of results are given below. Use one of these three schemes. The report must contain enough specific information that the sampling scheme can be duplicated exactly.

4.3.1 Discretionary sampling

In discretionary sampling, a human operator intervenes to select features for analysis, based on some subjective criteria.

4.3.1.1 Procedure

1 For each attribute, establish decision rules for selecting regions.

Example 1 — “Select the 10 regions with the highest apparent mottle.”

Example 2 — “Find the 3 lightest character images. Find the 3 darkest character images.”

2 Visually inspect the page and select regions that meet the criteria.

3 Evaluate the attribute within each region selected.

4.3.1.2 Specification of sampling scheme

If this sampling method is selected, the report must specify:

1 all decision rules used

2 location of each region evaluated, for each attribute.

4.3.2 Random sampling

In random sampling, features are taken from a portion of the page that has been selected blindly to represent the whole page.

4.3.2.1 Procedure

1 Cover the page with a grid of uniform rectangular cells.

2 Select a cell at random (using any random or pseudorandom method that ensures that each cell has the same chance of being selected as any other).

3 If the attribute being evaluated does not apply to the cell, discard it and select a replacement.

4 Evaluate the attribute within the cell.

5 Sample cells until the desired accuracy is obtained.

4.3.2.2 Specification of sampling scheme

If this sampling method is used, the report must specify:

1 dimensions of the grid cells

2 method of placing grid on page

a location of origin

b orientation of axes

3 decision rule for deciding if attribute is applicable to cell

4 any other decision rules used

5 decision rule for deciding when to stop sampling

6 method of randomization in selection of grid cells

7 stratification, if any. (Stratification is dividing the grid into homogeneous sections and then selecting samples from each section according to a predetermined proportion of the total number of samples.)

4.3.3 Whole page sampling

In whole page sampling, features are extracted from throughout the page.

4.3.3.1 Procedure

Divide the page into the cells and measure each attribute (if present) in each cell.

4.3.3.2 Specification of sampling scheme

If this sampling method is selected, the report must specify:

1 dimensions of the grid cells

2 method of placing grid on page

a location of origin

b orientation axes

3 decision rule for deciding if attribute is applicable to cell

4 any other decision rules used.

5 Attributes and their measures

5.1 Schema of attributes

This clause contains the schema of image quality. The attributes in each group generally require similar assumptions and have similar or related measurement procedures.

Type of Attribute	Attribute	Clause
Large area density attributes	darkness, large area	5.2.1
	background haze	5.2.2
	graininess	5.2.3
	mottle	5.2.4
	extraneous marks, background	5.2.5
	voids	5.2.6
Character and line attributes	blurriness	5.3.1
	raggedness	5.3.2
	line width	5.3.3
	darkness, character	5.3.4
	contrast	5.3.5
	fill	5.3.6
	extraneous marks, character field	5.3.7
	background haze, character field	5.3.8

5.2 Large area density attributes

This clause contains definitions and measuring procedures for attributes characterizing areas larger than 21,2 mm x 21,2 mm.

All measurements described in this clause shall be made under the conditions prescribed in Clause 6.

5.2.1 Darkness, large area

The optical density of an image element, measured using an aperture that has an area of at least 19,6 mm^2 and a minimum dimension of 5 mm. The measurement must be taken wholly within the image element. The darkness is the average optical density of the ROI.

Note — The requirements for this measurement are met by the sampling scheme described for graininess and mottle (5.2.3.1). In this case, the large area darkness would be characterized by the average of the averages m_i.

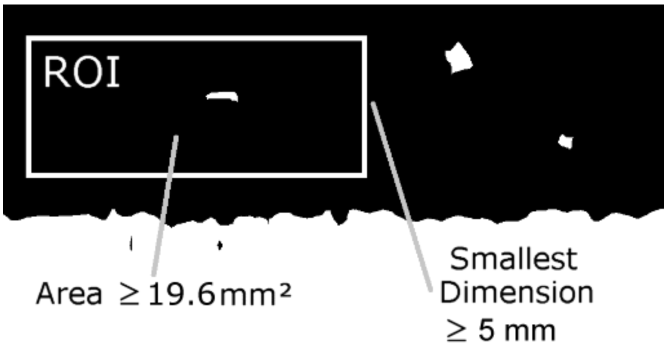

Figure 2 — Large area darkness

5.2.2 Background haze

Colourant that is visible in the background field but that cannot be resolved as individual marks at standard viewing distance by the unaided eye. The measure of background haze in the ROI is the average optical density of the ROI in the background (with marks excluded), measured using an aperture that has an area of at least 19,6 mm^2 and a minimum dimension of 5 mm. The measurement must be made at least 500 micrometres away from the boundary of any image element.

Note — The requirements for this measurement are met by the sampling scheme described for graininess and mottle (5.2.3.1), applied in the background field. In this case, the background haze would be characterized by the average of the averages m_i.

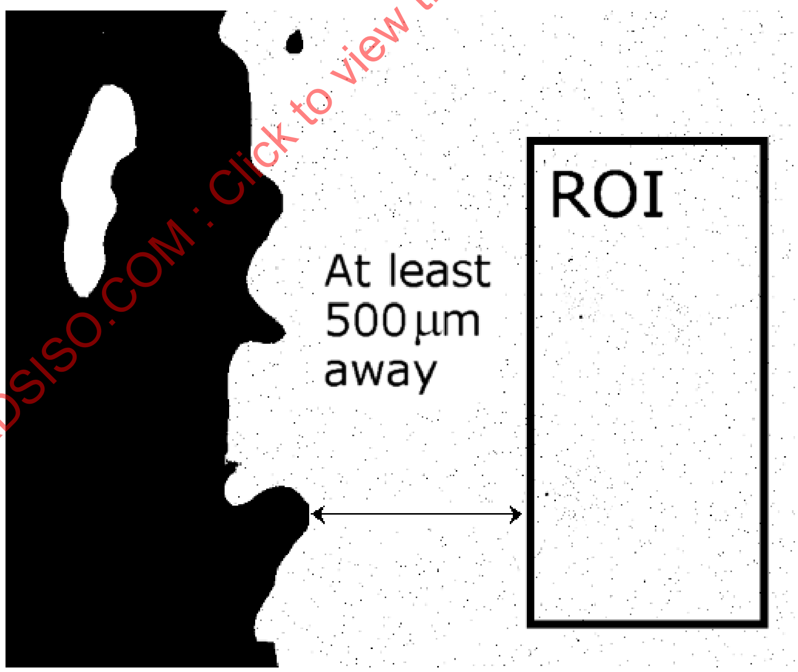

Figure 3 — Background haze

5.2.3 Graininess

Aperiodic fluctuations of density at a spatial frequency greater than 0,4 cycles per millimetre in all directions. The measure of graininess across the ROI is $\sqrt{(\Sigma_i \sigma_i^2)}/n$ where σ_i is the standard deviation of optical density measurements within tile i and n is the total number of tiles. (See Figure 5.)

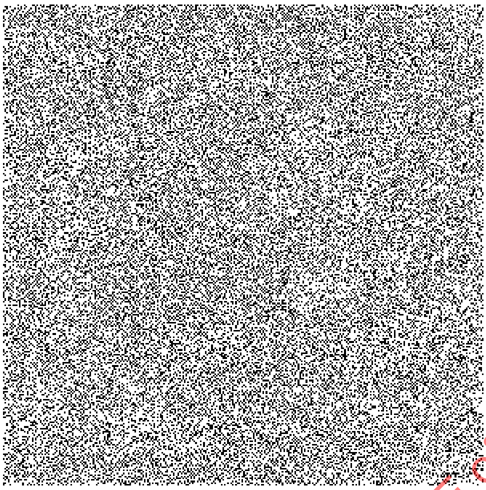

Figure 4 — Graininess

5.2.3.1 Sampling for the graininess and mottle measurement

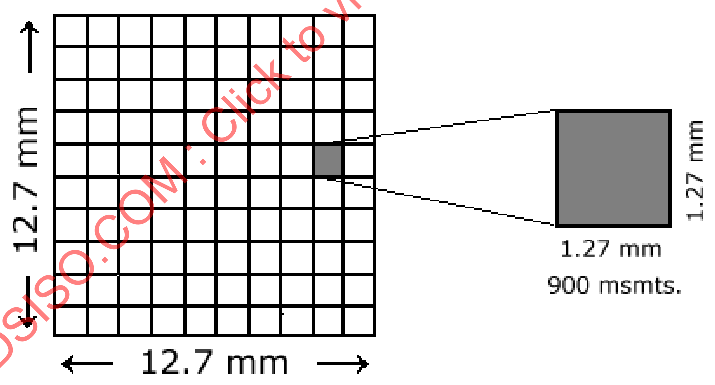

Figure 5 — ROI divided into tiles; a tile (with dimensions)

Find a region of interest (ROI) of at least 161 mm^2, with smallest dimension at least 12,7 mm, contained wholly within the area. Divide the ROI into at least 100 uniform, non-overlapping square tiles with area at least 1,61 mm^2 and smallest dimension at least 1,27 mm.

Within each tile, make 900 evenly-spaced, non-overlapping measurements of density. For each tile i, m_i is the average of these measurements; σ_i is the standard deviation of the measurements.

Note — For a 600 spi detector system, this corresponds to a region of 90.000 pixels divided into tiles of 900 pixels.

5.2.4 Mottle

Aperiodic fluctuations of density at a spatial frequency less than 0,4 cycles per millimetre in all directions. The measure of mottle across the ROI is the standard deviation of the m_i, where m_i, is the average of density measurements within tile *i*. The m_i are obtained as described in 5.2.3.1.

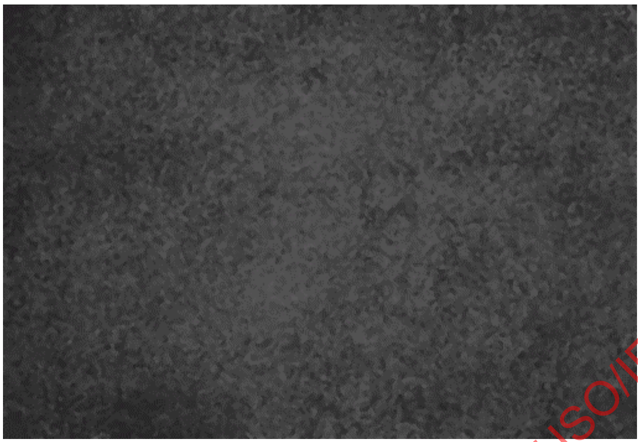

Figure 6 — Mottle

5.2.5 Extraneous marks, background

Colourant particles or agglomerations of colourant particles in the background area (at least 500 micrometres from any image element) that are visible as distinct marks at standard viewing distance to the unaided eye. The measure of extraneous marks is the area (in square micrometres) within the edge threshold of each mark of at least 100 micrometres in the smallest dimension. Report the results as a list of all marks and their areas along with the area of the ROI or as a summary. For a summary, report the total area of all the marks divided by the area of the ROI.

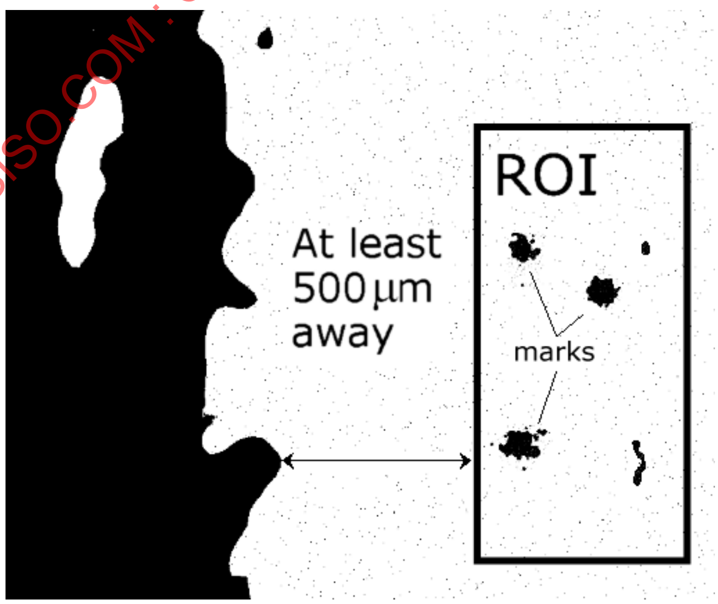

Figure 7 — Background extraneous marks

5.2.6 Voids

Visible holes or gaps within a solid image area that are large enough to be individually distinguished at standard viewing distance by the unaided eye. The measure of voids is the area (in square micrometres) of each hole of at least 100 micrometres in the smallest dimension within a nominally solid image area. The areas are measured within the edge threshold of these marks. Report the results as a list of all voids and their areas along with the area of the ROI or as a summary. For a summary, report the total area of all the marks divided by the area of the ROI.

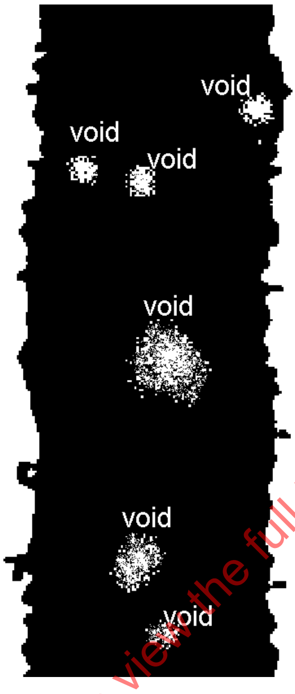

Figure 8 — Voids

5.3 Character and line attributes

This clause contains definitions and measuring procedures for attributes applicable to character images (and their near vicinity) and to lines at least 1,27 mm long.

A *character* is a symbol drawn from a defined character set (for example, a letter, digit, or punctuation mark). A *character field* is the region of a page near a character image or other image element. This region runs from the outer boundary edge of the character image or other image element out 500 micrometres.

These attributes also apply to lines at least 1,27 mm long. In this case, the interior of the line is taken to be the interior of the line that falls within the ROI.

Note — Blurriness, raggedness, and extraneous colourant in the character field are caused by similar processes and their effects are often confounded. This International Standard does not attempt to completely separate the effects in the proposed measurement methods, so (for example) the blur measurement may contain some component of raggedness or the raggedness measurement may contain some component of extraneous marks.

All measurements described in this clause shall be made under the conditions prescribed in Clause 6.

5.3.1 Blurriness

The appearance of being hazy or indistinct in outline; a noticeable transition of blackness from background to character. The measure of blurriness is the average distance between the inner and outer boundary edges.

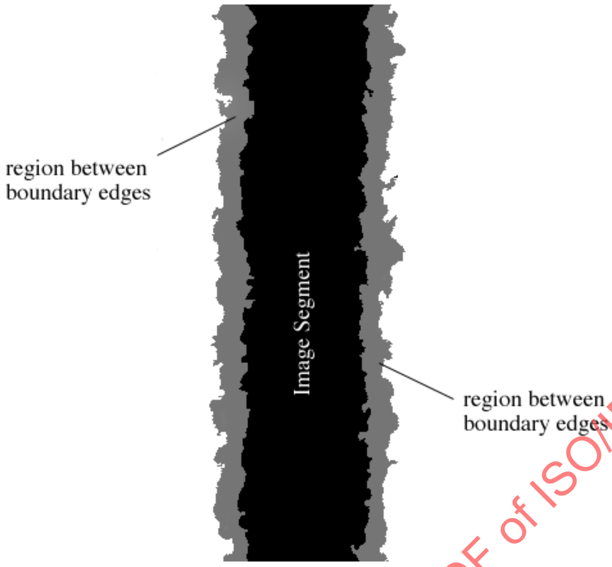

Figure 9 — Blurriness

5.3.2 Raggedness

The appearance of geometric distortion of an edge from its ideal position. A ragged edge appears rough or wavy rather than smooth or straight. The measure of raggedness is the standard deviation of the residuals from a line fitted to the edge threshold of the line (calculated perpendicular to the fitted line).

Note — The raggedness evaluation is optimized for use with edges containing aperiodic noise.

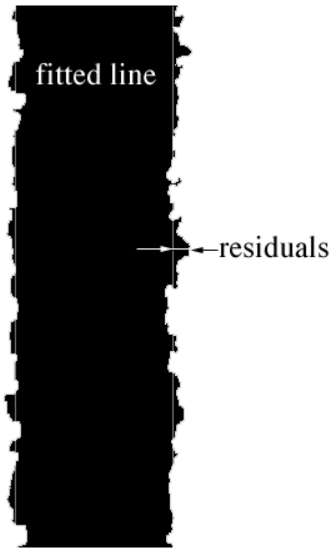

Figure 10 — Raggedness

5.3.3 Line width

Line width is the average stroke width, where the stroke width is measured from edge threshold to edge threshold along a line normal to the centre line of the image element, sampled at a rate of at least 600 per inch.

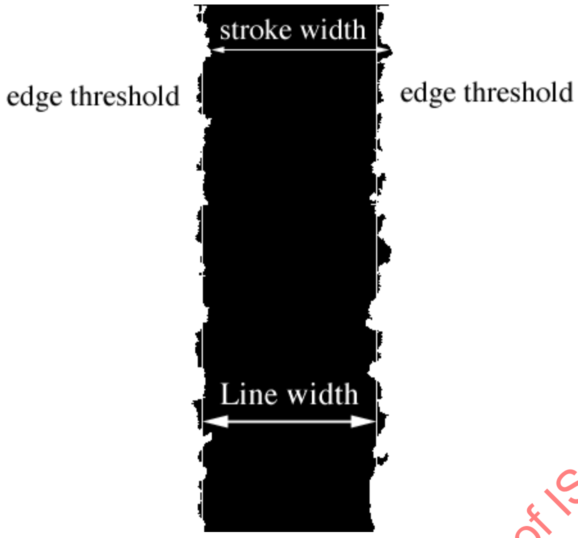

Figure 11 — Line width

5.3.4 Darkness, character

Appearance of blackness of a line or character image. The measure of character darkness is the mean density within the R_{75} boundary edge.

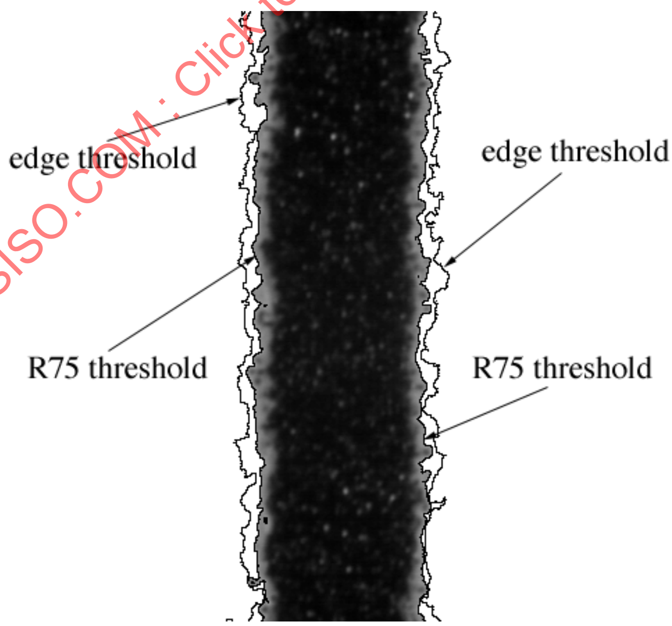

Figure 12 — Character darkness

5.3.5 Contrast

The relationship between the darkness of a line segment, character image, or other glyph image

and its field. Calculated using the standard formula $contrast = (R_{field} – R_{image}) / R_{field}$ where R_{field} is the

mean reflectance factor of the surrounding character field (including marks, haze, and substrate) and R_{image} is the mean reflectance factor within the inner boundary edge of the image segment.

5.3.6 Fill

Appearance of homogeneity of darkness within the boundary of a line segment, character image, or other glyph image. The measure of fill is the ratio of the area with 75% relative reflectance value or more within the inner boundary to the total area within the inner boundary.

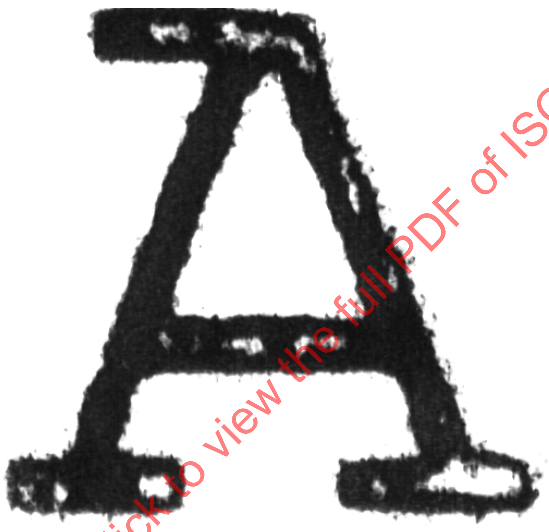

Figure 13 — Fill

5.3.7 Extraneous marks, character field

Colourant particles or agglomerations of colourant particles within a character field that are visible as distinct marks at standard viewing distance to the unaided eye. The measure of extraneous marks in the character field is the ratio of the area of the marks to the total area of the character field. The area of the marks is measured within the edge threshold of marks with one dimension at least 100 micrometres.

Note — Extraneous marks that appear within a character field are sometimes called *satellites.*

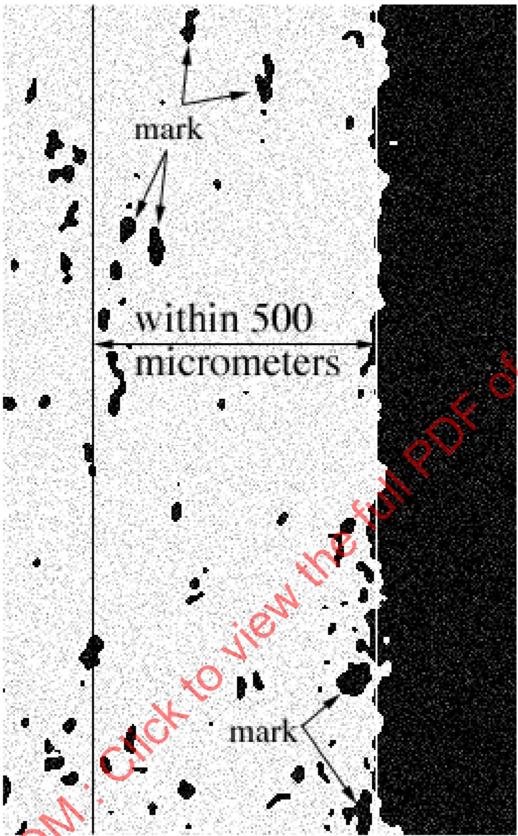

Figure 14 — Character field extraneous marks

5.3.8 Background haze, character field

Colourant particles or agglomerations of colourant particles within a character field that are visible but not resolvable as distinct marks at standard viewing distance to the unaided eye. The measure of character haze in the background field is the ratio of the mean reflectance factor of the character field (with marks and image elements excluded) to the reflectance factor of the nearby background field (outside any character field).

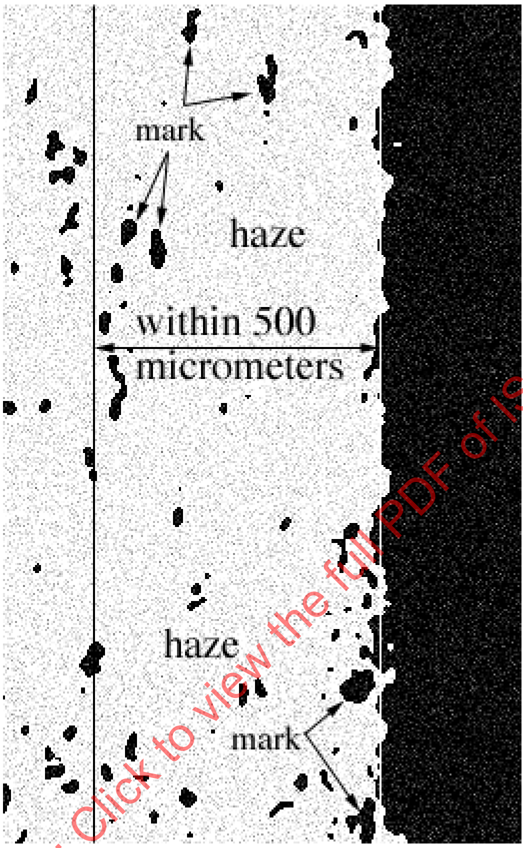

Figure 15 — Character field background haze

6 System compliance

The purpose of this test is to verify that the complete measuring system (hardware, software, and operator) has been well calibrated and that it is accurate and precise enough for the requirements of this International Standard. This clause does not describe a calibration procedure. It describes a procedure for verifying that suitable calibration has been achieved.

6.1 Compliance standard

The instrument system used to carry out the procedures of this International Standard shall be tested using the test objects and procedures specified below to assure that it is operating in compliance with the requirements of this International Standard.

The measuring system is calibrated suitably if it can obtain a value within acceptable tolerances of the goal values given in Clause 6.4 for each attribute and for each test object specified in Clause 6.3, independent of the orientation of the object and of its location within the field of view.

6.2 Instrument

The measures in this International Standard must be carried out with an instrument that has a minimum of 600 spi and 8 bits per pixel (256 gray levels), with a large field of view (for example, a 600 spi flatbed scanner) and a dynamic range of at least 0,1 to 1,5. A 600 spi instrument has an optical sampling pitch of 42,3 micrometres in the vertical and horizontal direction and a sampling window of close to 42,3 micrometres x 42,3 micrometres. The measures described in the standard assume that data has been collected on such an instrument.

Any instrument may be used, however, as long as the compliance standard in this clause can be met.

Note — To achieve optimal comparison between systems, instruments should have similar characteristics (spi, illumination, spectral response).

6.3 Test objects

The system compliance procedure requires the use of several test lines. These test objects shall be produced as specified or procured from a qualified test standard producer.

6.3.1 Specification for production of lines

The lines are built from the bitmaps in Annex A.

1 Each test line is produced by duplicating the corresponding bitmap at least 50 times, to produce a line that is at least 30 mm long.

2 In each bitmap, “0” defines a white pixel. “1” defines a black pixel.

3 Each pixel shall be square and sharp, with an area between 700 square micrometres and 1100 square micrometres.

4 The total area of any 3 x 3 block of adjacent pixels shall be between 7600 and 9600 square micrometres.

5 The substrate shall have Bendtsen smoothness of at least 300 ml/min and a TAPPI brightness of at least 85.

6 The colourant shall have an average density of 1,3 or higher.

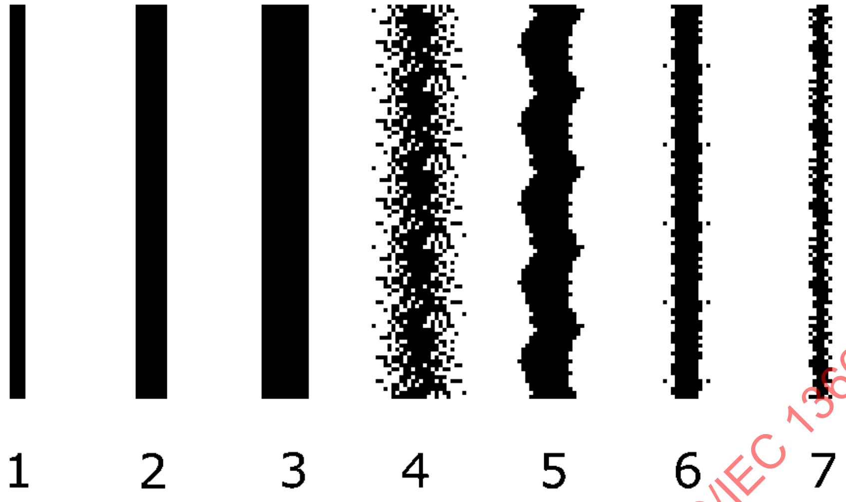

**Figure 16 — Sample of lines for compliance test.
(For illustration only. Not to be used to test compliance.)**

6.4 Goal Values

Table 1 — Goal values for system compliance test

Line	Blackness (density)	Line Width (micrometres)	Raggedness Left Side (micrometres)	Raggedness Right Side (micrometres)	Blurriness Left Side (micrometres)	Blurriness Right Side (micrometres)
1	0,74 – 0,93	128 – 136	2 – 5	2 – 5	95 – 112	9 – 116
2	0,86 – 1,04	238 – 250	2 – 5	2 – 5	102 – 123	101 – 121
3	0,89 – 1,06	354 – 367	2 – 5	2 – 5	105 – 126	107 – 128
4	0,82 – 1,00	423 – 454	20 – 25	1 – 19	221 – 240	229 – 249
5	0,89 – 1,05	346 – 363	30 – 32	2 – 29	134 – 153	135 – 153
6	0,85 – 1,03	215 – 228	5 – 7	7 – 10	116 – 134	116 – 134
7	0,74 – 0,92	142 – 152	9 – 11	6 – 8	103 – 122	108 – 128

Annex A
(normative)

Bitmaps for compliance test lines

Table 2 — Bitmap for Line 1

```
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
000000000011110000000000
```

Table 3 — Bitmap for Line 2

```
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
000000001111111100000000
```


