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Micrographics — Methods of measuring image quality produced by aperture card scanners —

Part 2: Quality criteria and control

Micrographie — Méthodes de mesurage de la qualité de l'image produite par les numériseurs de cartes à fenêtre —

Partie 2: Critères et contrôle de qualité

Reference number
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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
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Foreword

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

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.

Attention is drawn to the possibility that some of the elements of this part of ISO 11698 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 11698-2 was prepared by Technical Committee ISO/TC 171, *Document imaging applications*, Subcommittee SC 1, *Quality*.

ISO 11698 consists of the following parts, under the general title *Micrographics — Methods of measuring image quality produced by aperture card scanners*:

— *Part 1: Characteristics of the test images*

— *Part 2: Quality criteria and control*

Annexes A and B of this part of ISO 11698 are for information only.

Introduction

Scanning of microimages in aperture cards for use in CAD and electronic information systems is of great importance. This International Standard provides means of evaluating the output quality of images resulting from scanning of aperture card microimages. The procedures may be used to establish and maintain image quality achieved by a scanner.

The specification of the test microimages can be found in ISO 11698-1.

Micrographics — Methods of measuring image quality produced by aperture card scanners —

Part 2:
Quality criteria and control

1 Scope

This part of ISO 11698 specifies methods for using the test images specified in ISO 11698-1 to check the quality of images produced by aperture card scanners.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 11698. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 11698 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 3272-1:1983, *Microfilming of technical drawings and other drawing office documents — Part 1: Operating procedures.*

ISO 5457:1999, *Technical product documentation — Sizes and layout of drawing sheets.*

ISO 6196-1:1993, *Micrographics — Vocabulary — Part 1: General terms.*

ISO 6196-4:1998, *Micrographics — Vocabulary — Part 4: Materials and packaging.*

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

ISO 6196-6:1992, *Micrographics — Vocabulary — Part 6: Equipment.*

ISO 6428:1982, *Technical drawings — Requirements for microcopying.*

ISO 12651:1999, *Electronic imaging — Vocabulary.*

3 Terms and definitions

For the purposes of this part of ISO 11698, the terms and definitions in ISO 6196 and ISO 12651 apply. Where a term appears in both of these standards it is essential that the definition used is appropriate to the context of the term. The following terms and definitions also apply.

3.1
barrel distortion
distortion in an image in which a specific point within the image is relatively farther from its optical axis than the corresponding point on the original, typified by a rectangle having one of its sides bowed outward

3.2
image offsets
adjustment device of a scanner that allows the capture size area to be moved relative to the nominal position that is specified in the relative International Standard for the aperture of an aperture card

3.3
pincushion distortion
distortion in an image in which a specific point within the image is relatively closer to its optical axis than the corresponding point on the original, typified by a rectangle having one of its sides bowed inward

3.4
resolving power
numerical expression of the limit of resolution of an imaging system, expressed as the number of lines per millimetre discernible in an image of a test chart

3.5
scaling error
relationship between the nominal and actual numbers of pixels or dots per length in an output electronic image

3.6
scanner offsets
adjustments of the scanner system that calibrate the position of the capture area to be centralized over the standard card aperture area when image offsets are set to zero

3.7
test card
aperture card or piece of photographic film having the same dimensions, containing a test image in the aperture or equivalent area

3.8
test image
area of a test card that contains test targets, patterns, etc., intended for measuring quality of image produced by an aperture scanner

3.9
test target
target comprising elements such as test charts, patterns and characters, used for assessing the quality of output from an imaging system

4 Methods of use

4.1 General

Because of its impact on the accuracy of other tests, evaluation of focus shall be made first. Other tests may be made in any order, taking account of interdependence of results as indicated in the method.

Test images shall be scanned into an electronic imaging system. Output images, on screen or as hard copy, shall be examined to assess quality level of characteristics. For a given bit-mapped image this may be different from its ultimate image on screen or as hard copy. Some characteristics shall be assessed by visual inspection, others by measurement.

For measurement of screen images, a calibrated electronic viewing system by which any pixel in view can be displayed as an X direction and Y direction pixel count from a reference corner of an image shall be used. The lines

in the image shall be aligned within ± 2° with the corresponding axis of the measuring device of the viewing system. Errors in alignment greater than two degrees are likely to affect the accuracy of scaling and capture size tests.

For measurement of hard copy images, appropriate allowance shall be made for error introduced by the printer and it is essential that the magnitude of any printer error be determined by separate calibration of the printer.

Either or both methods may be used for evaluation but an electronic viewing measurement system is usually capable of producing more accurate results. No criteria for characteristics are specified. These are for the user to decide.

4.2 Establishing a quality reference

To establish the quality reference the system shall be working at optimum level for all types of material to be scanned. Each of the test images specified in ISO 11698-1[1)] and any other test image made by the user shall be scanned, regenerated as hard copy print of corresponding A size and evaluated. If the quality of the printed output is acceptable the prints shall be retained for reference and the reference bit-mapped images securely retained on a separate disk. All scanner adjustment settings and all other system settings used to make the reference prints shall be recorded.

5 Test methods

5.1 Focus

5.1.1 Set the scanner for the highest resolution and reduction ratio, and allows the full test image area to be scanned.

5.1.2 Scan a type 4 test image and display the resulting image on a monitor screen or print it.

5.1.3 Examine the test targets and record the letter of smallest pattern that can be resolved in each set of patterns in all the test targets.

5.1.4 Check that the lines ruled in the background area are clearly separate over the complete image area.

NOTE Adjusting the focus of a scanner may require a special tool and procedures that are only available to service technicians. However, it is important to ensure that the quality of focus is maintained and this test image enables focus to be checked and measured.

5.2 Image centring

5.2.1 Set the scanner offsets correctly.

5.2.2 Set the image offsets to zero.

5.2.3 Load a type 1 test image into the scanner.

5.2.4 Scan the test image and display the resulting image on a monitor screen or print to fit a sheet of paper of size in the ISO A series. Note cut-off readings on the metric scales of one horizontally and one vertically connected pair. Calculate the deviation from centre in each direction by subtracting the smaller reading from the larger one and dividing the result by two. For a paper print it will be necessary to correct the result for any deviation from nominal size of the sheet and any error in positioning introduced by the printer.

1) Test images are available from Applied Image Group/Imaging, 1653 East Main Street, Rochester, New York 14609 USA. Tel: (716) 482-0300. Fax: (716) 288-5989.
Website address: www.appliedimage.com E-mail address: imaging@appliedimage.com

5.3 Image scaling

5.3.1 Set the scanner to scan the sheet size indicated on the type 1 test image to be scanned.

5.3.2 Set the pixel length and pixel width to the values obtained by multiplying the relative dimension of the sheet as specified in ISO 5457 by the scanning frequency in pixels per millimetre.

5.3.3 Set the reduction ratio to that specified in ISO 3272-1 for the sheet size being used.

5.3.4 Scan the test card and display the resulting image on a monitor screen or print to the sheet size indicated on the test image, using a printer having printing resolution equivalent to that of the scanner.

5.3.5 On the screen image, using a calibrated electronic viewing system, determine the number of pixels along the lines HF and EG between the centre pixels in the perpendicular lines defining the ends of HF and EG. Divide the numbers obtained by the scanning resolution used in the test to give length of the lines in millimetres.

5.3.6 On the printed image measure the lengths of lines HF and EG to the nearest millimetre. Correct for any error due to inaccuracy in enlargement ratio of the printer.

5.4 Image capture size

5.4.1 Set the scanner to scan the sheet size indicated on the type 1 test image to be scanned.

5.4.2 Ensure that the scaling is correct as in 5.3.

5.4.3 Check that the pixel length and pixel width set for the sheet size correspond to the standard ISO sheet size multiplied by the resolution to be used in the test.

5.4.4 Check that the reduction ratio set for the sheet size being used is equal to the nominal reduction ratio specified in ISO 3272-1 for the sheet size being used.

5.4.5 Scan the test image and display the resulting image on a monitor screen or print it.

5.4.6 Observe the display or the print. Absence of broken lines, with readings of 2,0 mm on each of the corner scales indicate correct image capture/scan size if there is no centring or scaling error.

Whether or not broken lines are present, unequal readings on each corner scale indicate centring error.

Equal readings on all the corner scales having a value other than 2,0 mm indicate scaling error.

In interpreting the results of this test due allowance must be made for any error in centring or scaling revealed by tests in accordance with 5.2 and 5.3.

5.5 Line straightness

5.5.1 Set the scanner to scan the sheet size indicated on the type 1 test image to be scanned.

5.5.2 Scan the test card and display the resulting image on a monitor screen or print it.

5.5.3 On the screen image, using a calibrated electronic viewing system in combination with a vector overlay facility, select each of the lines in the rectangular grid in turn and join each end by an overlaid vector line. Enlarge the display in regions of maximum deviation between the raster line and the vector line and measure the maximum deviation between the two lines, in pixels, in a direction normal to the line. Express the maximum deviation in millimetres, obtained by dividing the number of pixels counted by the resolution used in pixels per millimetre.

5.5.4 On the print select each of the lines in the rectangular grid in turn and using a straight edge carefully draw a fine line between the ends of the line. Measure the maximum deviation using a graticule under magnification.

5.6 Orthogonality

Before deviation from orthogonality, caused by misalignment of the scanning device, can be measured accurately, it must be demonstrated by the method in 5.5 that lines in the scanned image and on the print are straight.

5.6.1 Set the scanner to scan the sheet size indicated on the type 1 test image to be scanned.

5.6.2 Scan the image card and display the resulting image on a monitor screen or print it.

5.6.3 On the screen image, using a calibrated electronic viewing device, place the cursor on the point of intersection of lines EG and HF and note the coordinates of that point. Move the cursor along both of the lines in turn by about 1000 pixels. Record the new cursor position in each case and from the three cursor position readings calculate the angle of intersection, θ, using the formula:

$$\theta = \frac{1}{\tan\frac{(P_y - O_y)}{(P_x - O_x)}} - \frac{1}{\tan\frac{(Q_y - O_y)}{(Q_x - O_x)}}$$

where

O_x and O_y are the coordinates of O;

P_x and P_y are the coordinates of the point of measurement on OE;

Q_x and Q_y are the coordinates of the point of measurement on OF.

The amount of deviation from 90 degrees is the orthogonality error.

On the print place a protractor over the intersection point of lines EG and HF and measure the angle by which the lines differ from 90 degrees to obtain the deviation from orthogonality.

5.7 Uniformity of line width

5.7.1 Set the scanner to scan the sheet size indicated on the type 1 test image to be scanned.

5.7.2 Scan the test card and display the resulting image on a monitor screen or print it.

5.7.3 On the screen image, display at high magnification the centre line HF at a minimum of 10 points equally spaced along its length. Using a calibrated electronic viewing system determine the width of the line at those points, normal to the line direction. Repeat this procedure for each vertical, horizontal and diagonal line in the rectangle ABCD.

On the print measure the width of line HF at five equally spaced points, normal to the line, using a graticule under minimum magnification $\times$ 10. Repeat this procedure for each vertical, horizontal and diagonal line in the rectangle ABCD.

5.8 Resolving power

5.8.1 Set the scanner to scan a test image type 2.

5.8.2 Scan the test image and display the resulting image on a monitor screen or print it.

5.8.3 On the screen image, using the highest magnification available, and on the print examine each segment of Pestrecov star on all of the test targets. Resolving power is indicated by the associated scale at the point where all nine component lines cease to be clearly distinguishable. Alternatively examine both sets of ISO No. 2 test patterns on all test targets. Resolving power is indicated by the number of the smallest pattern in which all five lines are clearly distinguishable in both directions. Express resolving power as line pairs per millimetre.

5.9 Resolvable line width

5.9.1 Set the scanner to scan the sheet size indicated on the type 3 test image to be scanned.

5.9.2 Scan the test image and display the resulting image on a monitor screen or print it.

5.9.3 Adjust the scanner to give optimum resolution over the whole field of the image.

5.9.4 On an image produced under conditions of optimum resolution determine the number of the smallest set of lines that can be clearly resolved, in both directions, of all three line sets of each pattern in every target on the test image.

5.10 Character legibility

5.10.1 Set the scanner to scan a test image type 5.

5.10.2 Scan the test image and display the resulting image on a monitor screen or print it.

5.10.3 Note the smallest character string in which all the characters are legible.

5.11 Subjective assessment

Some scanner features, such as image enhancement, are designed to perform best when scanning typical engineering drawings and can give unpredictable results when scanning artificial targets such as those described in the main body of this standard. For this reason it is often helpful to include one or more test images that are typically representative of those to be scanned. Test image type 6 may be used for this purpose.

Annex A
(informative)

Routine subjective assessment

Test image type 6 provides a means of routine assessment of performance of an electronic imaging system. The test image should be scanned and printed to make a reference print when the scanner is known to be in peak working condition. On a routine basis or in case of doubt as to performance level a fresh print should be made and compared with the reference print. For a practised user this may be a quick and useful way to assess day-to-day performance of the system.