INTERNATIONAL STANDARD

ISO 12653-3

First edition
2014-04-01

Electronic imaging — Test target for scanning of office documents —

Part 3: Test target for use in lower resolution applications

Imagerie électronique — Cible d'essai pour le scanning en noir et blanc des documents de bureau —

Partie 3: Applications à plus faible résolution

Reference number
ISO 12653-3:2014(E)

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Published in Switzerland

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 171, *Document management applications*, Subcommittee SC 1, *Quality*.

ISO 12653 consists of the following parts, under the general title *Electronic imaging — Test target for scanning of office documents*:

— *Part 1: Characteristics*

— *Part 2: Method of use*

— *Part 3: Test target for use in lower resolution applications*

Introduction

This part of ISO 12653 describes procedures for evaluating the quality of output from office document scanning systems that are set to scan documents up to 300 dpi. The systems can be used to scan in black and white, in greyscale, or in colour.

Test charts and targets already exist for micrographics and facsimile transmission but they are specific to these said fields and do not meet the needs of the users of document scanning systems.

ISO 12653-1 specifies a test target for use in general scanning systems, to enable their performance to be evaluated and to establish performance limits of the systems. Its method of use is specified in ISO 12653-2.

Electronic imaging — Test target for scanning of office documents —

Part 3:
Test target for use in lower resolution applications

1 Scope

This part of ISO 12653 specifies a test target for assessing the consistency of the output quality over time from lower resolution reflection scanning systems.

It is applicable to assessing the output quality of black-and-white and colour scanners used for black-and-white or colour office documents, with or without half tone.

It does not apply to scanners used for the scanning of transparent or translucent documents.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5-4:2009, *Photography and graphic technology — Density measurements — Part 4: Geometric conditions for reflection density.*

ISO 446:2004, *Micrographics — ISO character and ISO test chart No. 1 — Description and use.*

ISO 3334:2006, *Micrographics — ISO resolution test chart No 2 — Description and use.*

ISO 12653-1:2000, *Electronic imaging — Test target for the black-and-white scanning of office documents — Part 1: Characteristics*.

ISO 12653-2:2000, *Electronic imaging — Test target for the black-and-white scanning of office documents — Part 2: Method of use*.

ISO 12653-2:2000 / Cor:1:2002

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12651 and the following apply.

3.1
test element
pattern represented on a target

EXAMPLE Millimetre scale, grey scale, circle.

3.2
continuous tone
tonal variation in a document represented by areas of different density

3.3
lower resolution application
scanning system that is configured to scan up to 300 dpi

4 Uses of this part of ISO 12653

4.1 General

The method described in Clause 8 of this part of ISO 12653 for assessing the output quality of office document scanners (both black-and-white and colour) can be used in the following:

— to initially set up the system to yield satisfactory images;

— to check for consistent quality;

— to check that equivalent performance is being obtained from another system.

If the whole system is checked, from input to output, the results obtained can vary depending on the different items of equipment used. For example, one visual display unit screen can be poorly set up, giving worse quality than a well set up screen. It is thus important to establish the parts of the system on which to perform the tests. If tests of other parts of the system are required, then the tests should be repeated as appropriate.

The regular use of these procedures should enable a given level of quality to be maintained. The method is intended

— to enable the operator to check that the scanner is correctly set up,

— to inform the operator of the capabilities and limits of the scanner,

— to enable the user to monitor image quality over a period of time, and

— to enable the user to draw up quality assessment procedures.

4.2 Factors affecting quality

Factors which affect the quality achieved by a document scanning system are

— physical scanning irregularities,

— uniformity of exposure,

— chromatic sensitivity of the photosensing unit,

— contrast,

— threshold setting,

— reproduction of half-tones,

— resolution, and

— scale.

5 Test target

5.1 General

The black and white and colour test targets specified in this part of ISO 12653 include characters and graphics as test elements.

5.2 Description of the test elements

The test target shall comprise of the following display elements, arranged as shown in Figures 1 and 2.

The test target shall include the words “FOR USE AT UP TO 300 dpi ONLY”.

The test elements on the targets should be of such quality that scanners being assessed reach a point of failure. Determination of this point will enable the user to ascertain the characteristics of documents that are unlikely to produce an acceptable image.

NOTE The sample layout of the test target shown in Figure 1 is a reduced reproduction. The test target would normally fill a whole A4 size page.

The test elements as described below refer to the areas on the test target as indicated by the area letters shown in Figure 2.

a) Area A:

— 10-mm–wide frame subdivided into 2 mm parallel lines which delineate the outer edge of the target;

— 12 arrow-shaped elements, three on each side of the target, whose outward points touch the outer edges of the target.

b) Area B:

— diagonal line with two marks 300 mm apart designating the ends of the diagonal line and end marks are equidistant from the centre of the target. (The line is blanked out where it crosses elements K and N.)

c) Area C:

— three equally spaced concentric circles with a cross indicating their centre point;

— a Pestrecov star pattern, with associated areas indicating frequency in lines per millimetre at each of the clear circles of the star, is composed of tapered black and white radial lines over 360° having equal angular frequency and concentric white circles at frequencies equivalent to 1,8 lines per millimetre, 2,5 lines per millimetre, and 3,6 lines per millimetre.

d) Area D:

— group of international standard characters (see ISO 446) having heights in the R20 series, 56 µm x 10 to 280 µm x 10.

e) Area E:

— selection of characters of various sizes and type styles, including at least one serif and at least one sanserif font, with the smallest character size used smaller than the smallest character size normally scanned by the system. The character size and type style used can be indicated on the test target. Characters used can be Latin type and/or non-Latin type depending upon end-user requirements. White characters on a black background can be added if appropriate.

f) Area F:

— two ISO No 2 test charts (see ISO 3334) having frequencies in the R20 series 2,0 to 7,1 line pairs/mm. One test chart shall be aligned at 45° to the line of scanning.

g) Area G:

— two contiguous rectangles each divided into 10 zones; one rectangle shall have a white background and the other shall have a black background. Each rectangle shall have lines of opposite polarity progressively changing zone-by-zone in width from 0 to 0.5 mm. Where these lines cross zone boundaries, they shall be of opposite polarity to the line. Line widths shall be indicated. One test chart shall be aligned at 90° to the line of scanning, a second test chart shall be aligned to the direction of scanning.

h) Area H:

— horizontal and vertical rectangular areas of uniform visual diffuse reflection density, measured in accordance with ISO 5-4, minimum density 1,2.

i) Area I:

— selection of widely spaced small non-alphanumeric characters.

j) Area J:

— area of background (white) colour at least 30 mm x 30 mm, delineated by a black border of at least 1mm width.

k) Area K:

— four scales of half-tone wedges, each wedge ranging from 10 % to 100 % in increments of 10 %, one each in cyan, magenta, yellow and black at screen size 6,9 lines/mm.

NOTE The grey scale range represents the percentage of black to white in the half-tone.

l) Area L:

— four areas of uniform continuous density, ranging in steps from 0,3 to 1,2 density.

m) Area M:

— two scales of half-tone grey wedges at different screen sizes, each wedge ranging from 0 % to 90 % in increments of 10 % at screen sizes 3,3 and 6,9 lines/mm.

n) Area N:

— six ladder patterns, three in each direction. Ladder patterns shall be at 1,8, 2,5 and 3,6 lines/mm.

o) Area O:

— colour image with areas of varying colours.

p) Area P:

— arrows to indicate in which direction the target shall be placed in the scanner.

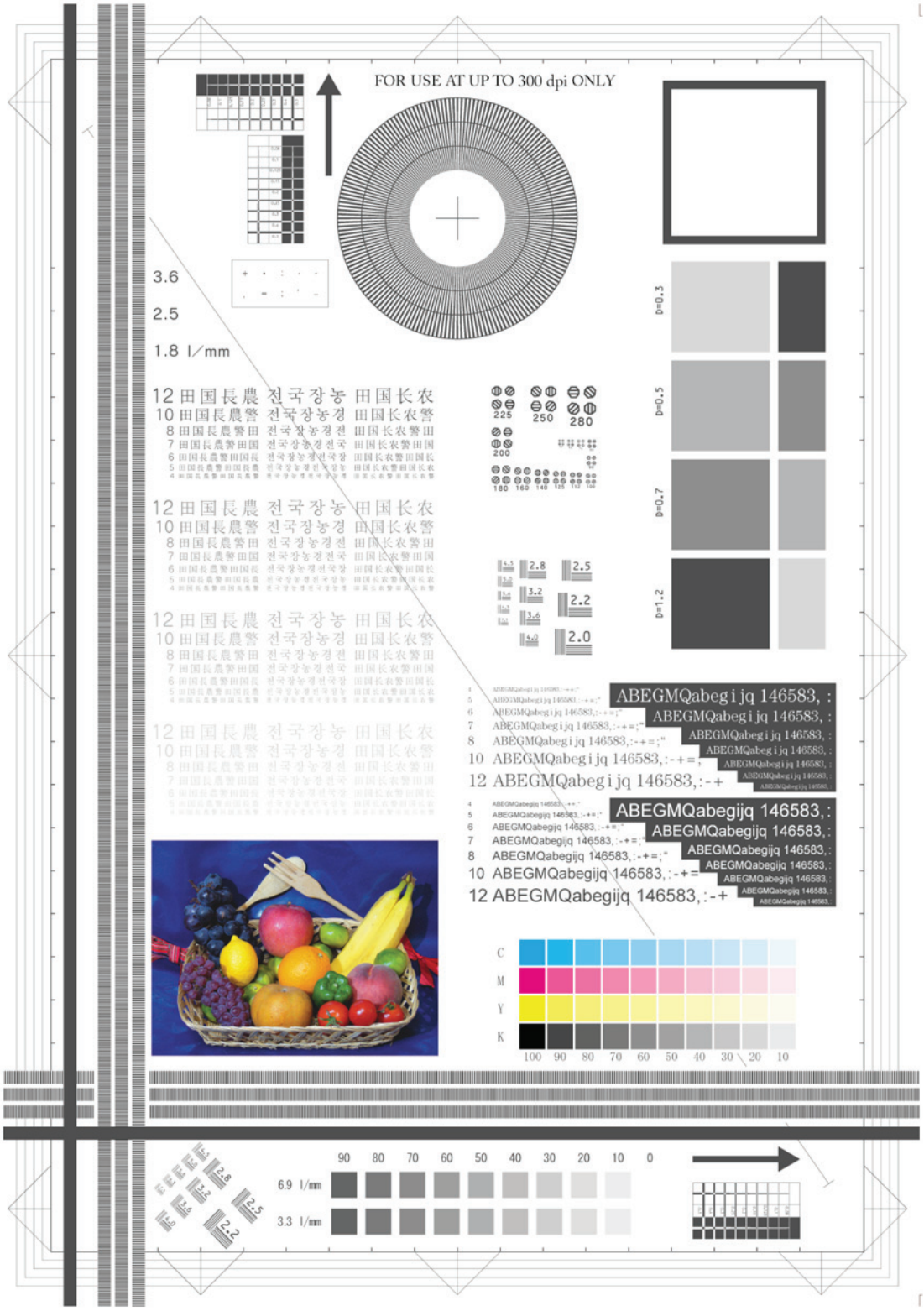


Figure 1 — Sample layout of test target

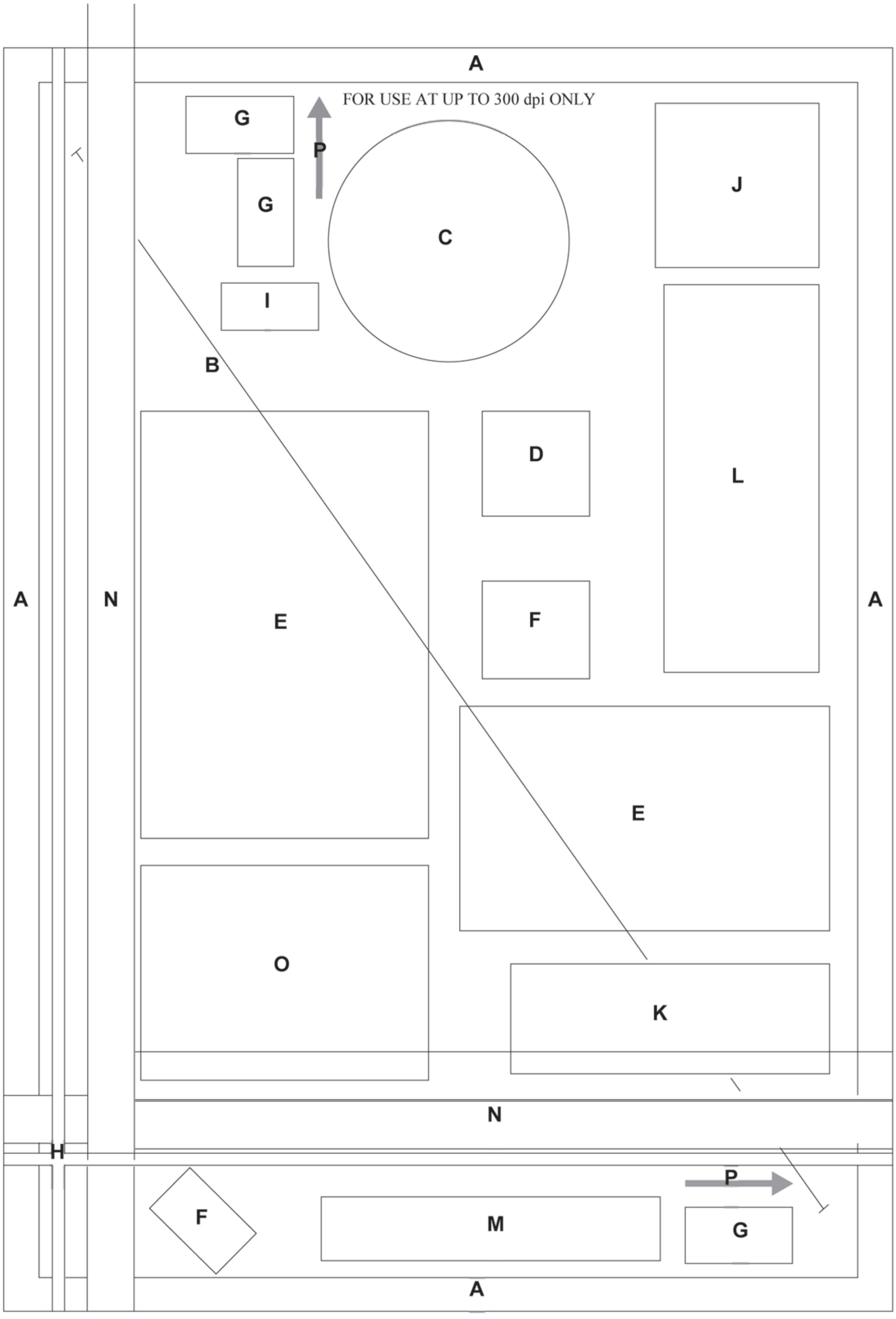


Figure 2 — Layout of target area (see 4.2)

5.3 Base

The test target shall be made on a white opaque base with a glossy surface. The base size shall be that typical of documents normally scanned (for example, A4).

5.4 Test target for duplex scanners

The target described in 5.2 may be created as a single-sided or as a double- sided target. Where double sided, there shall be identical designs on the two sides, except for an indication of the side (e.g. Front, Back) displayed.

6 Procedures

6.1 Initial system set-up

Tests shall be run under normal operational conditions. Any required warm-up period shall be allowed before these tests are carried out. Where appropriate, initial calibration routines shall be performed, in accordance with the manufacturer's instructions, before these tests are carried out.

6.2 Use of image enhancement and compression

The quality of output of a scanning system can be modified by the use of image enhancement and compression techniques. For these tests, the system shall be operating under normal conditions with scanner settings as used for normal documents. It can be an advantage during the initial testing to establish the best settings for these controls. Software changes can introduce different enhancement or compression techniques. New initial tests may be needed for validation after such changes.

6.3 Test target scanning

When a test target is scanned, it shall be positioned correctly in the scanner. If the scanner incorrectly moves the target, the resultant image shall be rejected if any major quality problems are evident. For example, if the target alignment is substantially incorrect due to a problem with the paper path, the target shall be re-scanned.

Scan the test target (see Figure 1), and either view or print the image.

NOTE Figure 1 is for information only. It is a reduced reproduction and should not be used as a test target.

6.4 Internal test systems

Many systems include test procedures in their software. These tests can be performed in conjunction with the test targets defined in this part of ISO 12653.

6.5 Frequency

The frequency of testing of a system should be set by the user, taking advice from the system supplier. It is preferable to test a system prior to the scanning of a batch of documents, and where necessary, at the end of the batch. The tests shall also be performed after any maintenance operation or when any system component is changed.

7 Evaluation of the results

7.1 Evaluation

A description of the test to be undertaken is given in 8.2 for each test element on the test target.

The results obtained should be checked on a screen or on hard copy. The results obtained on a screen may not agree with those obtained on hard copy print out. In general, the legibility on screen is inferior to that of output on paper. However, both output methods should be used as this can show deficiencies particular to one of the output devices being used. For quality control purposes, a reference data file of quality control images should be maintained.

7.2 Screen resolution

If a screen resolution 96 dpi is used to evaluate a target scanned at 200 dpi, then a zoom ratio of 2:1 will approximate the scanned resolution on the screen. A 2:1 image zoom is achieved when, for example, an area A notch which is 10 mm on the original target becomes 20 mm on the screen when zoomed.

8 Test method

8.1 Test elements

A list of the test elements are given in Table 1. Details of each test on these elements of the test target and their method of interpretation are given in 8.2.

Table 1 — Description and list of test elements

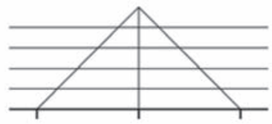
Test no.	Characteristics measured	Target area	Purpose of the test
1	Framing 1	A	Determine completeness of scan.
2	Framing 2	A	a) Measure image displacement. b) Measure output scale.
3	Diagonal line scanning	B	Determine accuracy of reproduction of a diagonal line.
4	Circle scanning	C	Determine accuracy of reproducing a circle.
5	Legibility 1	D	Determine minimum size of ISO No 1 test characters that can be clearly reproduced.
6	Legibility 2	E	Determine minimum sizes of characters of different typographical styles that can be clearly reproduced.
7	Resolution 1	F	Determine resolving power of the system.
8	Resolution 2	C	Determine effect of orientation on resolution.
9	Resolution 3	G	Determine limit of ability to reproduce fine detail.
10	Uniformity	H	Determine uniformity of reproduction of a solid.
11	Continuous tone reproduction	L	Determine accuracy of reproduction of a continuous tone, density step wedge.
12	Half tone reproduction	M	Determine limits of ability to reproduce half-tones in a range of screen sizes.
13	Isolated small characters	I	Determine ability to reproduce small non-alphanumeric characters.
14	White space	J	Determine the clarity of reproduction of white space.
15	Colour half-tone reproduction	K	Determine limits of ability to reproduce colour half-tones.
16	Smoothness of scan	N	Determine whether the scanner paper transport mechanism works smoothly, thus resulting in an image without distortion.
17	Colour reproduction	O	Assess general colour reproduction characteristics.

8.2 Test procedures

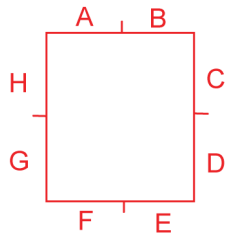
Test numbers 1 to 17 shall be executed using original test targets and not from copies thereof.

The tests described shall be carried out on a screen and/or on an hard-copy output as appropriate.

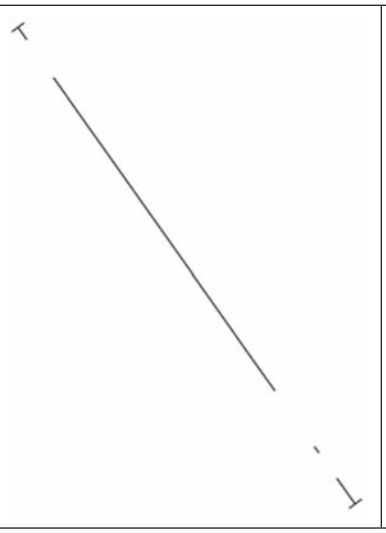
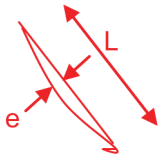
Test number 1

Designation – framing 1	**Target area A**
Purpose of the test	Determine completeness of scan.
Description of element	 Wedge shapes, the acute angle of which touches the edge of the test target.
Evaluation	Check that all the arrow-shaped elements are visible and as complete as the scanner permits.
Calculation	None.
Interpretation	Indicates the proper positioning of the test target in the scanner. Checks the correctness of the position of the framing marks or of introduction guides.
Observations	This test has significance only if the complete image can be displayed.

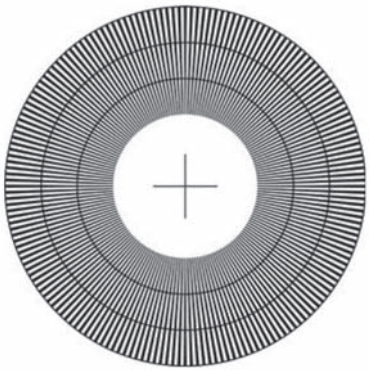
Test number 2

Designation – framing 2	Target area A		
Purpose of the test	a) Measure image displacement. b) Measure output scale.		
Description of element			Frame of parallel lines 2 mm apart at the target edges. 19 notch marks along the long edge and 16 notch marks along the short edge at 10 mm spacing with the centre notch aligned to the centre of the wedge shapes
Evaluation 	Note the cut off at all four sides of the frame. Measure the lengths A, B and so on.		
Calculation	a) Vertical placement: |A-B|, |F-E|, Horizontal placement: |C-D|, |H-G| b) Scale = Length of side of an image/length of that side on test target		
Interpretation	If there is uniform cut-off at any edge, there is lateral displacement toward that edge. If there is non-uniform cut-off along edges, there is rotation. Vertical: if |C-D| = |H-G| = 0 → centred. |C-D| = |H-G| ≠ 0 → decentred. |C-D| ≠ |H-G| → decentred and/or rotation. Horizontal: if |A-B| = |F-E| = 0 → centred. |A-B| = |F-E| ≠ 0 → decentred. |A-B| ≠ |F-E| → decentred and/or rotation. Decide if the placement and reproduction scales are acceptable.		
Observations	Measurements are difficult to take accurately on a curved screen.		

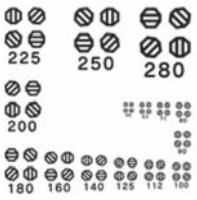
Test number 3

Designation – diagonal line scanning	Target area B	
Purpose of the test	Determine accuracy of reproduction of a diagonal line.	
Description of element		Diagonal line with two reference marks 300 mm apart designating the ends of the diagonal line. The end marks are equidistant from the centre of the target.
Evaluation 	a) Measure the length (L) of the output diagonal between two reference marks. b) Measure the maximum deviation (e) of the output line from a notional straight line between the two reference marks.	
Calculation	a) Length inaccuracy (%) = (300 – L) / 300 × 100 % b) Straightness inaccuracy (%) = e / L x 100 %	
Interpretation	a) 300 - L < 0:image is enlarged 300 - L > 0: image is reduced b) If e ≠ 0: image is distorted	
Observations	Validity of this test can be affected by a difference in input and output resolution. The test can also be used to check aliasing.	

Test number 4

Designation – circle scanning	Target area C	
Purpose of the test	Determine accuracy of reproduction of a circle.	
Description of element		Three equally spaced concentric circles with a cross indicating their centre point. Vertical diameter = D_v Horizontal diameter = D_h
Evaluation	Measure with a graduated rule the vertical and horizontal diameters of each circle.	
Calculation	Geometric distortion = D_v / D_h	
Interpretation	Geometric distortion ≠ 1 can indicate: • scanning speeds not uniform for scanner and/or printer; • resolution of the output device not adequate.	
Observations	Accuracy of results can be affected by a difference in horizontal and vertical scanning speeds. The majority of scanners give a geometric distortion ≠ 1	

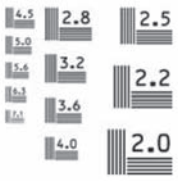
Test number 5

Designation – legibility 1	Target area D	
Purpose of the test	Determine minimum size of ISO No 1 test characters that can be clearly reproduced.	
Description of element		Part of ISO test chart No.1 (see ISO 446).
Evaluation	In accordance with the method in ISO 446 determine the smallest character resolved.	
Calculation	The number of the smallest resolved character x 10 gives the height of the resolvable character in micrometres.	
Interpretation	The number of the smallest ISO No. 1 character resolved gives an indication on the minimum height of characters which can be reproduced.	
Observations	Legibility of output can be better than that of the ordinary documents as a result of a better contrast and the accuracy of reproduction of the test characters.	

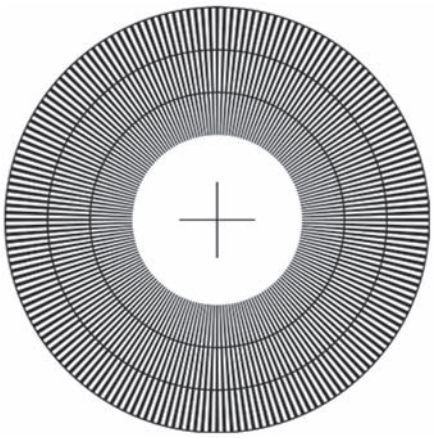
Test number 6

Designation – legibility 2	Target area E		
Purpose of the test	Determine minimum sizes of characters of different typographical styles that can be clearly reproduced.		
Description of element			Characters of different fonts and sizes. See 'Area E' in 5.2 for further details
Evaluation	Identify and count the legible characters. Determine the smallest legible size.		
Calculation	None.		
Interpretation	Gives an indication of the height of characters that can be reproduced. Indicates character fonts compatible with the resolution of the system.		
Observations	Legibility of output can be better than that of the original document as a result of a better contrast.		

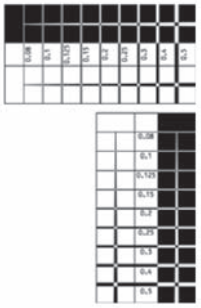
Test number 7

Designation – resolution 1	Target area F	
Purpose of the test	Determine resolving power of the system.	
Description of element		Part of ISO Test Chart No. 2 (see ISO 3334). The element is used in two areas on the target – on the line of scanning and at 45° to the line of scanning.
Evaluation	In accordance with the method in ISO 3334 determine the definition of the smallest pattern that can be resolved.	
Calculation	None.	
Interpretation	Number of the smallest pattern of the test chart that can be resolved indicates the resolving power in lines pairs per millimetre of the scanning system.	
Observations	The effects of slight rotation of the test target can have a significant effect on resolution readings. The target orientated at 45° often shows more accurate results.	

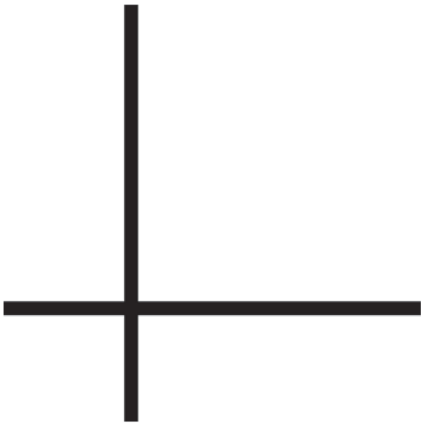
Test number 8

Designation – resolution 2	Target area C	
Purpose of the test	Determine effect of orientation on resolution.	
Description of element		Part of a Pestrecov star with concentric white circles at frequencies equivalent to 1,8, 2,5, and 3,6 lines per millimetre.
Evaluation	Measure the smallest and largest dimensions of the confusion area.	
Calculation	None.	
Interpretation	The distance of the blurring from the centre is an indication of resolution.	
Observations	At the centre of the target, the lines are very narrow and reproduction will cause blurring at varying distances from the centre. This test can display Moiré effect.	

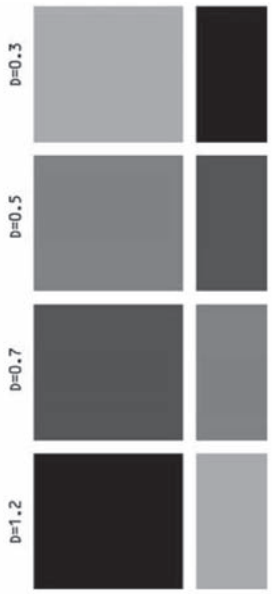
Test number 9

Designation – resolution 3	Target area G	
Purpose of the test	Determine limit of ability to reproduce fine detail.	
Description of element		Target with segments, negative- and positive-appearing, having lines of progressively changing width, numbers indicating width of line in mm.
Evaluation	Determine the number of the smallest segment which can be seen across the entire width on the negative element and on the positive element in each of the patterns on the test chart.	
Calculation	None.	
Interpretation	The highest numbers are respectively the limits of resolution in millimetres for negative appearing and positive appearing lines.	
Observations	None.	

Test number 10

Designation – uniformity	Target area H	
Purpose of the test	Determine uniformity of reproduction of a solid.	
Description of element		Black rectangles of uniform high density.
Evaluation	Examine images of the element for uneven density, streaks, and/or edge defects.	
Calculation	None.	
Interpretation	Visual defects indicate poor uniformity in reproduction.	
Observations	None.	

Test number 11

Designation – continuous tone reproduction	Target area L	
Purpose of the test	Determine accuracy of reproduction of a continuous tone, density step wedge.	
Description of element		Step wedges having densities from 0,3 to 1,2.
Evaluation	Determine the densities of the two step wedges output by the system. NOTE This can be assessed by visual comparison with patches of known densities.	
Calculation	None.	
Interpretation	Initial tests should be conducted for each threshold setting available on the scanner. Enables the checking of the efficiency and the range of action of this setting.	
Observations	None.	

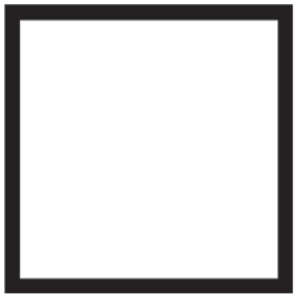
Test number 12

Designation – half tone reproduction	Target area M	
Purpose of the test	Determine limits of ability to reproduce half-tones in a range of screen sizes.	
Description of element		Two grey-scale wedges ranging from 10 % to 90 % in increasing 10 % steps at screen sizes 3,3 and 6,9 lines/mm.
Evaluation	Examine the dots resolved by the system. Note the step in each wedge in which the dots are resolved.	
Calculation	None.	
Interpretation	None.	
Observations	None.	

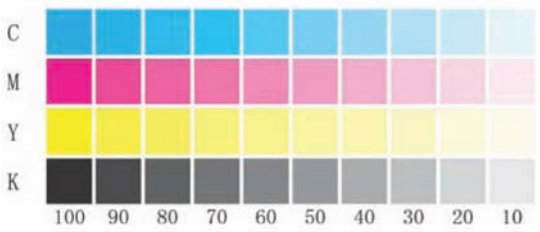
Test number 13

Designation – isolated small characters	Target area I	
Purpose of the test	Determine ability to reproduce small non-alphanumeric characters.	
Description of element		Selection of widely spaced small non-alpha-numeric characters.
Evaluation	Visual examination of small characters to ascertain whether they can be recognized as such after scanning.	
Calculation	None.	
Interpretation	None.	
Observations	None.	

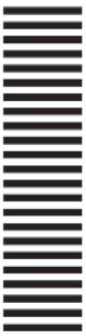
Test number 14

Designation – white space	Target area J	
Purpose of the test	Determine the clarity of reproduction of white space.	
Description of element		Area of at least 30 mm x 30 mm at background density, bounded by a black border.
Evaluation	Assess whether any greyness is visible in the test area.	
Calculation	None.	
Interpretation	None.	
Observations	Brightness of the background can be examined and measured.	

Test number 15

Designation – colour half-tone reproduction	Target area K	
Purpose of the test	Determine limits of ability to reproduce colour half-tones.	
Description of element		Four scales of half-tone wedges, each wedge ranging from 10 % to 100 % in increments of 10 %, one each in cyan, magenta, yellow, and black at screen size 6,9 lines/mm.
Evaluation	Examine the evenness of colour resolved by the system. Compare colours obtained with those on the test target.	
Calculation	None.	
Interpretation	None.	
Observations	Density reproduction of each colour can be examined.	

Test number 16

Designation – smoothness of scan	Target area N	
Purpose of the test	Determine whether the scanner paper transport mechanism works smoothly, thus resulting in an image without distortion.	
Description of element		Six ladder patterns, three in each direction. Ladder patterns shall be at 1,8, 2,5, and 3,6 lines/mm.
Evaluation	Assess whether the ladder patterns are accurately reproduced across the whole of the document length.	
Calculation	None.	
Interpretation	Lines closing together or smudging indicates unsmooth scanner travel.	
Observations	None.	

Test number 17

Designation – colour reproduction	Target area O	
Purpose of the test	Assess general colour reproduction characteristics.	
Description of element		Colour picture.
Evaluation	Compare colours obtained with those on the test target.	
Calculation	None.	
Interpretation	None.	
Observations	Reproduction of various colours can be examined.	

Bibliography

[1] ISO 12651-1:2012, *Electronic document management — Vocabulary — Part 1: Electronic document imaging.*

ICS 37.080

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