INTERNATIONAL STANDARD

ISO 12653-2

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Electronic imaging — Test target for the black-and-white scanning of office documents —

Part 2: Method of use

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

Partie 2: Méthodes d'utilisation

Reference number
ISO 12653-2:2000(E)

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Contents

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 12653 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 12653-2 was prepared by Technical Committee ISO/TC 171, *Document imaging applications*, Subcommittee SC 1, *Quality*.

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

— *Part 1: Characteristics*

— *Part 2: Method of use*

Introduction

This part of ISO 12653 describes procedures for evaluating the output quality of a black-and-white scanning system for office documents, using the test target specified in ISO 12653-1.

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.

Electronic imaging — Test target for the black-and-white scanning of office documents —

Part 2:
Method of use

1 Scope

This part of ISO 12653 specifies test methods for evaluating the consistency of the output quality over time from the black-and-white reflection scanning of office documents using the test target specified in ISO 12653-1 and other targets.

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

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

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 12653. 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 12653 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 446:1991, *Micrographics — ISO character and ISO test chart No. 1 — Description and use.*

ISO 3334:1989, *Micrographics — ISO resolution test chart No. 2 — Description and use.*

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

Recommendation ITU T.22, *Standardized test charts for document facsimile transmissions.*

3 Terms and definitions

For the purposes of this part of ISO 12653, the terms and definitions given in ISO 12651 and the following apply.

3.1
test element
pattern represented on a target

EXAMPLES Millimetre scale, grey scale, circle.

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

4 Method

4.1 General

The method for assessing the output quality of black-and-white scanners may be used in the following cases:

— initially to 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 may vary depending on the different items of equipment used. For example, one visual display unit screen may 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 are required of other parts of the system, 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;

— inform the operator of the capabilities and limits of the scanner;

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

— enable the user to draw up quality assessment procedures.

4.2 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;

— scale.

5 Procedures

5.1 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.

5.2 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 may be an advantage during the initial testing to establish the best settings for these controls. Software changes may introduce different enhancement or compression techniques. New initial tests may be needed for validation after such changes.

5.3 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[1)].

1) Test targets can be obtained from AFNOR, Tour Europe, Cedex 7, 92049 Paris La Défense, France. Tel: 33 (1) 42 91 55 55.

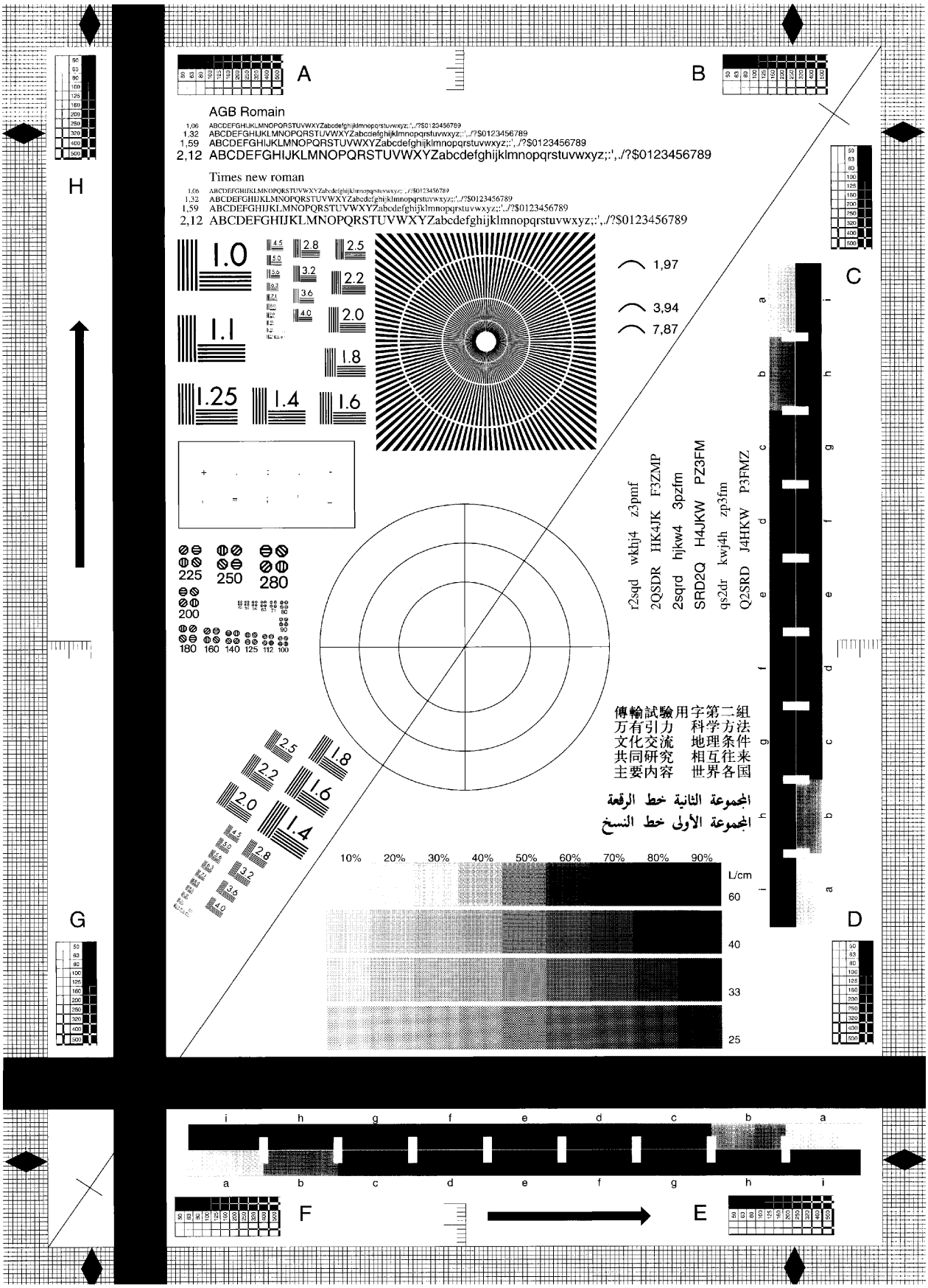


Figure 1 — Sample layout of test target

5.4 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.

5.5 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.

6 Evaluation of the results

A description of the test to be undertaken is given in 7.2, 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 Method

7.1 Test elements

A list of the test elements is given in Table 1. Details of each test on these elements of the test target are given in 7.2.

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 reproduction of 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 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	L	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	J	Determine accuracy of reproduction of a continuous tone, density step wedge.
12	Half-tone reproduction	K	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.

Figure 2 indicates the target area (see Table 1) of each test element of the test target.

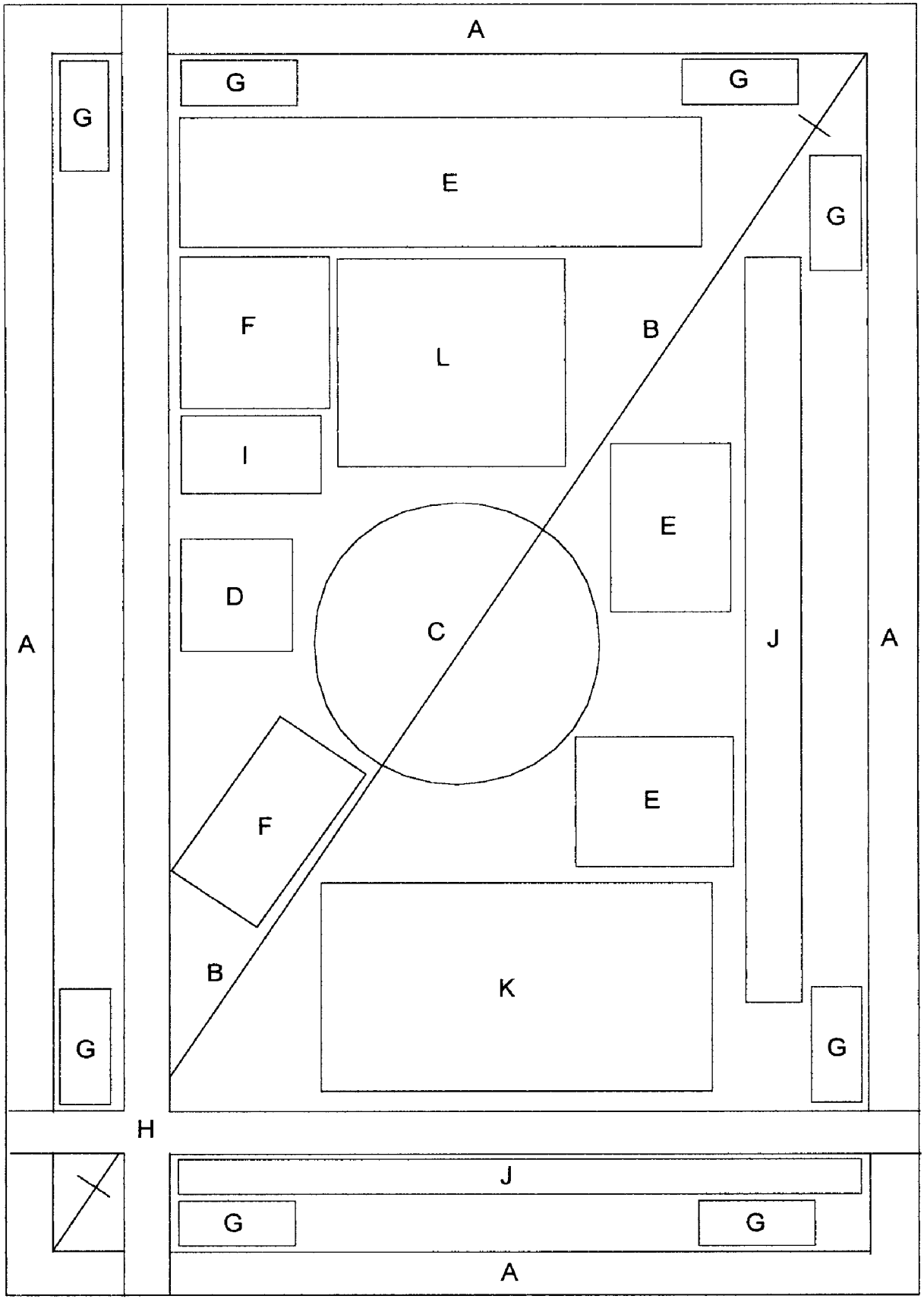


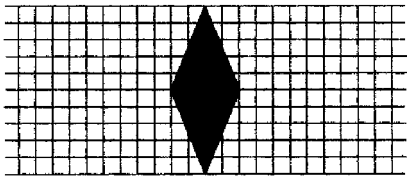
Figure 2 — Layout of target area sheet

7.2 Test procedures

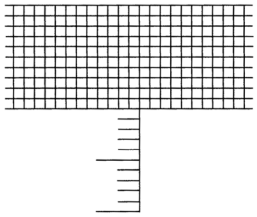
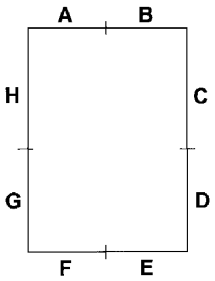
Tests numbers 1 to 13 shall be executed using original test targets and not from copies thereof.

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

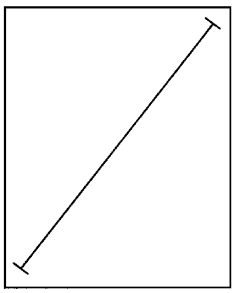
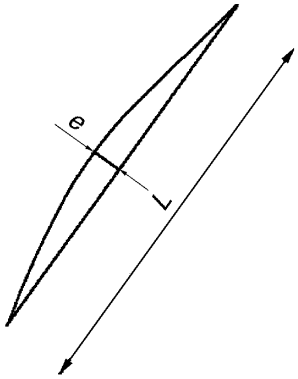
TEST Number 1

DESIGNATION **FRAMING 1**		**TARGET AREA** **A**
PURPOSE OF THE TEST	Determine completeness of scan.	
DESCRIPTION OF ELEMENT	 Diamond-shaped box, one acute angle of which touches the edge of the test target.	
EVALUATION	Check that all the diamonds 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.	

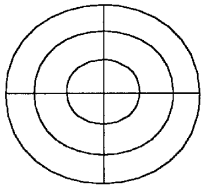
TEST Number 2

DESIGNATION FRAMING 2		TARGET AREA A
PURPOSE OF THE TEST	a) Measure image displacement. b) Measure output scale.	
DESCRIPTION OF ELEMENT		Frame graduated in millimetres at the target edge. Extension lines graduated in millimetres.
EVALUATION		a) 1. Note the cut-off at the corners of all four sides of the frame. 2. Measure the lengths A, B and so on. b) Measure the length of each of the four sides.
CALCULATION	a) 1. None 2. 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 towards 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.	

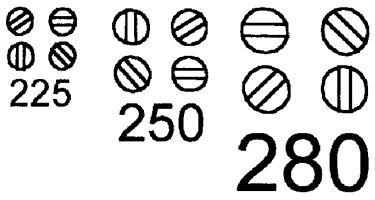
TEST Number 3

DESIGNATION DIAGONAL LINE SCANNING	TARGET AREA B
PURPOSE OF THE TEST	Determine accuracy of reproduction of a diagonal line.
DESCRIPTION OF ELEMENT	 Diagonal line through the centre of the target, with marks equidistant from the centre of the target. Length of the diagonal between reference marks: L_o
EVALUATION	 a) Measure the length (L) of the output diagonal between two reference marks. b) Measure the maximum deviation of the output line from a notional straight line between the two reference marks.
CALCULATION	a) Length inaccuracy (%) = $\frac{L_o - L}{L_o} \times 100$ b) Straightness inaccuracy (%) = $\frac{e}{L} \times 100$
INTERPRETATION	a) $L_o - L < 0$: image is enlarged $L_o - L > 0$: image is reduced b) If $e \neq 0$: image is distorted
OBSERVATIONS	Validity of this test can be affected by 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 centres coincident with that of the target, with horizontal and vertical diameter lines. 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 = $\frac{D_v}{D_h}$	
INTERPRETATION	Geometric distortion $\neq 1$ may 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 screens give a geometric deformation $\neq 1$.	

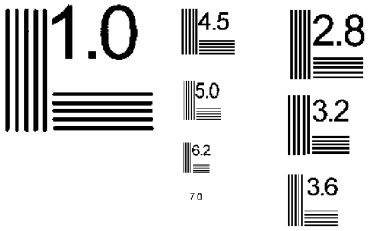
TEST Number 5

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 × 10 gives the height of the resolvable character in micrometres.	
INTERPRETATION	The number of the smallest ISO No. 1 character resolved gives an indication of the minimum height of characters which can be reproduced.	
OBSERVATIONS	Legibility of output may be better than that of the ordinary documents as a result of a better contrast and the accuracy of reproduction of the test characters.	

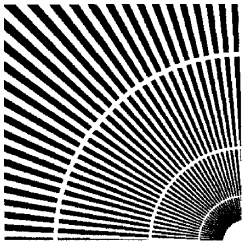
TEST Number 6

DESIGNATION LEGIBILITY 2				TARGET AREA E
PURPOSE OF THE TEST	Determine minimum size of characters of different typographical styles that can be clearly reproduced.			
DESCRIPTION OF ELEMENT	r2sqd 2QSDR2 2sqrd	wkhj4 HK4JK Hjkw4	z3pmf F3ZMP 3pzfm	Characters of different fonts and sizes.
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 may be better than that of the original document as a result of a better contrast.			

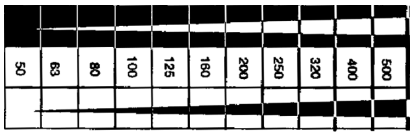
TEST Number 7

DESIGNATION LEGIBILITY 3		TARGET AREA F
PURPOSE OF THE TEST	Determine resolving power of the system.	
DESCRIPTION OF THE ELEMENT	 Part of ISO Test Chart No. 2 (see ISO 3334).	
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 pairs of lines per millimetre of the scanning system.	
OBSERVATIONS	None.	

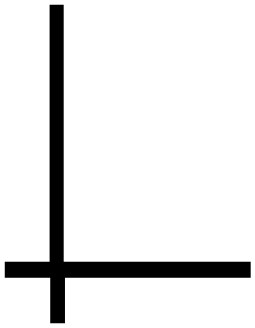
TEST Number 8

DESIGNATION RESOLUTION 2		TARGET AREA L
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 1,97, 3,94 and 7,87 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 may display Moiré effect.	

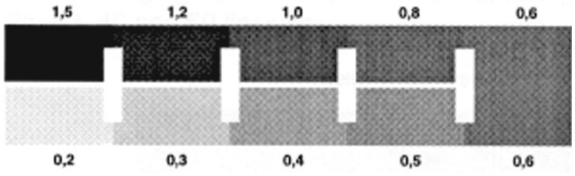
TEST Number 9

DESIGNATION RESOLUTION 3		TARGET AREA G
PURPOSE OF THE TEST	Determine limit of ability to reproduce fine detail.	
DESCRIPTION OF THE ELEMENT	 Target with segments, negative- and positive-appearing, having lines of progressively changing width numbers indicating width of line in μm.	
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 micrometres for negative-appearing and positive-appearing lines.	
OBSERVATIONS	None.	

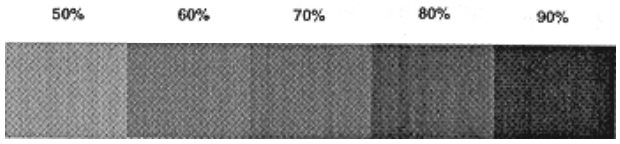
TEST Number 10

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 J
PURPOSE OF THE TEST	Determine accuracy of reproduction of a continuous tone, density step wedge.	
DESCRIPTION OF ELEMENT		Step wedges having densities from 0,2 to 1,5.
EVALUATION	Determine the densities of the two step wedges output by the system. NOTE This may 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 K
PURPOSE OF THE TEST	Determine limits of ability to reproduce half-tones in a range of screen sizes.
DESCRIPTION OF ELEMENT	Wedge ranging from 10 % to 90 % in increasing 10 % steps for screen size of 25, 33, 40 and 60 lines/cm.  lines/ cm 60
EVALUATION	Examine the dots resolved by the system. Note the step in each wedge in which the dots are resolved (e.g. 60 % on 60 lines/cm screen).
CALCULATION	None.
INTERPRETATION	None.
OBSERVATIONS	This test may display Moiré effect which may result in poor reproduction.

TEST Number 13

DESIGNATION SCANNING OF ISOLATED 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-alphanumeric characters.
EVALUATION	Visual examination of small characters to ascertain whether they can be recognized as such after scanning.	
CALCULATION	None.	
INTERPRETATION	None.	
OBSERVATIONS	None.	

8 Additional targets

8.1 General

Other test targets may be included in test procedures to evaluate other areas of quality of reproduction.

8.2 Continuous tone test target

A typical continuous tone target containing a black-and-white photograph is the Test Chart No. 5 "Continuous Tone Addendum" as described in ITU Recommendation T.22[2)]. This target should be scanned under the same conditions as specified in subclause 5.1 and should be evaluated by comparison with the original target.

8.3 Target 3: RIT Process Ink Gamut Chart

To assess tonal reproduction of colour, a Rochester Institute of Technology Process Ink Gamut Chart[3)] can be used. This chart contains a range of colours, printed using standard process inks.

The target shall be evaluated in two ways:

— for normal use, examine the tonal reproduction of the target, and compare it with the gamut chart;

— for use in testing colour blindness, examine the circle on the screen or printed hard-copy which most closely matches the colour of interest. The image should be dark grey.

2) The target as well as the recommendation mentioned can be obtained from the International Telecommunication Union, Place des Nations, CH-1211 Geneva 20, Switzerland.

3) Copies of the target can be obtained from AIIM International, 1100 Wayne Avenue, Suite 1100, Silver Spring, Maryland, 20910, USA Tel: (301) 587 8202, Fax: (301) 587 2711, E-mail aiim@aiim.org or the Rochester Institute of Technology, T & E Center, 1 Lomb Memorial Drive, Rochester, NY 14623, USA. Tel (716) 475 2411.

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