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Information technology — Automatic identification and data capture techniques — Optical Character Recognition (OCR) quality testing

Technologies de l'information — Techniques automatiques d'identification et de capture des données — Essais de qualité des caractères pour reconnaissance optique

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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 document 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).

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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 World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

Introduction

For the inspection of ID documents, i.e. MRTDs (Machine Readable Travel Documents) according to ISO/IEC 7501 (all parts)/ICAO Doc 9303 (all parts) and driving licences according to ISO/IEC 18013 (all parts), a reliable and ergonomic document inspection technology is essential. Considering RFID interoperability, strong improvement has been reached introducing mechanisms for interoperability evaluation and testing of MRTDs and reader devices. Similar standards for optical reading would improve the reliability of OCR. This is especially important because OCR of the document's MRZ (Machine Readable Zone) is essential for accessing BAC (Basic Access Control) and/or SAC (Supplementary Access Control) protected passports.

Thus, reliable OCR makes the performance of automated border control systems, as well as of many other applications, more predictable. Furthermore, the evaluation of document reader products can be done much easier. This standardization project defines test methods to evaluate OCR document quality. Furthermore, it defines requirements ensuring the compliance to the applicable OCR standards. The project applies experiences from other domains such as bar code reading and possibly other test methods for OCR. Where conflicts in the specification work between MRTDs and driving licenses may arise, satisfying the definitions for MRTDs is given preference.

Information technology — Automatic identification and data capture techniques — Optical Character Recognition (OCR) quality testing

1 Scope

This document

— specifies the methodology for the measurement of specific attributes of OCR-B character strings,

— defines a method for evaluating these measurements and deriving an overall assessment of character string quality,

— defines a reference decode algorithm for OCR-B, and

— gives information on possible causes of deviation from optimum grades to assist users in taking appropriate corrective action.

This document applies to OCR-B as defined in ISO 1073-2, but its methodology can be applied partially or wholly to other OCR fonts.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
binarized image
binary (black/white) image created by applying the global threshold to the *pixel* (3.5) values in the reference grey-scale image

3.2
document reference edge
physical (i.e. mechanical) end of the surface with the MRZ whose position is determined by putting a black background under the surface with the MRZ and sliding the document up against a physical stop

3.3
inspection area
rectangular area which contains the entire *symbol* (3.11) to be tested inclusive of its quiet zones

3.4
character outline limits
outlines of an ideal printed image of a character

Note 1 to entry: This is a qualitative evaluation utilized in ISO 1831 that is replaced in this document with SWT.

3.5
pixel
individual light-sensitive element in a light-sensitive array

Note 1 to entry: Examples of light-sensitive array are CCD (charge coupled device) or CMOS (complementary metal oxide semiconductor) device.

3.6
raw image
matrix of the reflectance values in x and y coordinates across a two-dimensional image, derived from the discrete reflectance values of each *pixel* (3.5) of the light-sensitive array

3.7
reference grey-scale image
raw image (3.6) convolved with a synthesized circular aperture

3.8
scan grade
result of the assessment of a single scan of an OCR symbol, derived by taking the lowest grade achieved for any measured parameter of the reference grey-scale and *binarized images* (3.1)

3.9
stroke width
nominal dimension perpendicular to the direction of the line making up an OCR character

3.10
stroke width template
inner and outer character boundaries defined by circles whose centres follow the line created by the character centreline coordinates defined in Annex A

3.11
symbol
group of OCR characters comprising the entire machine-readable entity (e.g. Machine Readable Zone (MRZ) as specified in ICAO 9303, sizes ID-1, ID-2 and ID-3) including quiet zones and the *document reference edge* (3.2)

Note 1 to entry: Document sizes are defined in ISO/IEC 7501 (all parts) (ICAO 9303) as TD1, TD2 and TD2, whereas the same sizes are defined in ISO/IEC 7810 as ID-1, ID-1 and ID-3. In this document, we use the terms ID-1, ID-2 and ID-3.

3.12
X-tolerance
0,08 mm for Size I with a nominal *stroke width* (3.9) of 0,35 mm

Note 1 to entry: 0,08 mm for Size I with a nominal stroke width of 0,35 mm was originally defined in ISO 1831:1980, Table 2.

3.13
Y-tolerance
0,15 mm for Size I with a nominal *stroke width* (3.9) of 0,35 mm

Note 1 to entry: 0,15 mm for Size I with a nominal stroke width of 0,35 mm was originally defined in ISO 1831:1980, Table 2.

4 Abbreviated terms

COL character outline limits

CEV character evaluation value

MRZ machine readable zone

SWT stroke width template

5 Quality grading

Quality grades for best-fit, PCS, position and background noise are determined as one of three levels: recommended, needs attention and not recommended. The parameter with the lowest grade is the grade of the symbol.

6 Measurement methodology for OCR-B

6.1 Overview of methodology

The basis of the measurement methodology is the evaluation of reflectance from the symbol. This methodology is also intended to correlate with conditions encountered in OCR scanning systems. The method starts by obtaining the raw image, which is a high-resolution grey-scale image of the symbol captured under controlled illumination and viewing conditions.

6.2 Obtaining the test image

6.2.1 Measurement conditions

A test image of the symbol shall be obtained in a configuration that mimics the typical scanning situation for that symbol, but with substantially higher resolution (see 6.3.3), uniform illumination and at best focus. The reference optical arrangement is defined in 6.3.4. Alternative optical arrangements may be used provided that the measurements obtained with them can be correlated with the use of the reference optical arrangement.

Ambient light levels shall be controlled in order not to influence the measurement results. Whenever possible, measurements shall be made on the symbol in its final configuration, i.e. the configuration in which it is intended to be scanned. For MRTD evaluation, optically personalized samples shall be used. This includes that all layers available at a document including laminations, security features and protective layers shall be present.

Two principles govern the design of the optical set-up. First, the test image's grey-scale shall be nominally linear and not be enhanced in any way. Second, the image resolution shall be adequate to produce consistent readings, which generally requires that the character stroke-widths span at least 10 image pixels.

6.2.2 Raw image

The raw image is a matrix of the actual reflectance values for each pixel of the light-sensitive array, from which are derived the reference grey-scale image and the binarized image which are evaluated for the assessment of symbol quality.

6.2.3 Reference grey-scale image

The reference grey-scale image is obtained from the raw image by processing the individual pixel reflectance values through a synthetic circular aperture equal to 0,2 mm.

6.2.4 Binarized image

The binarized image is obtained from the reference grey-scale image by applying the algorithm defined in Annex B.

6.3 Reference reflectivity measurements

6.3.1 General requirements

Equipment for assessing the quality of symbols in accordance with this subclause shall comprise a means of measuring and analysing the variations in the reflectivity of a symbol on its substrate over an inspection area which shall cover the full height and width of the symbol.

The measured reflectance values shall be expressed in percentage terms by means of calibration and reference to recognized national standards laboratories, where 100 per cent should correspond to the reflectance of a barium sulphate or magnesium oxide reference sample.

It should be ensured that all materials visible to the camera or close to the optical path are reflection-free, at least in IR illumination. In particular, the background the symbol is attached to shall be IR absorbing. The environment temperature shall be between 20°C and 25°C.

6.3.2 Light sources

Measurements shall be made using light emitting diode (LED) light sources at 890 nm and 940 nm wavelengths.

All illumination elements shall have a diameter of 25 mm or less and may be shaped as circles, squares or similar.

6.3.3 Effective resolution

The effective resolution of an instrument that implements this document shall be sufficient to ensure that the parameter grading results are consistent irrespective of the rotation of the symbol. The effective resolution is the product of the resolution of the light-sensitive array and of the magnification of the associated optical system and effected by distortions introduced by the optical system. The reference optical arrangement requires an effective resolution of not less than 10 pixels per stroke width.

6.3.4 Optical geometry

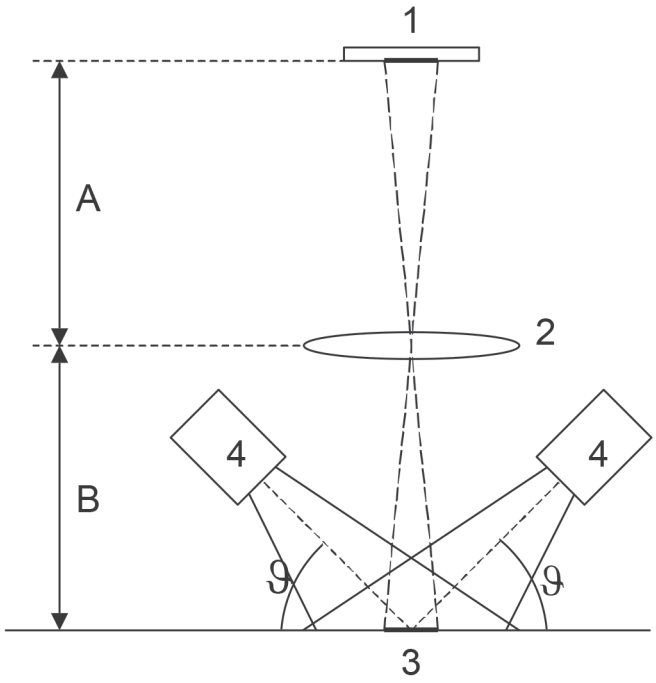
A reference optical geometry is defined for reflectivity measurements and consists of

— flood incident illumination, uniform across the inspection area, from a set of four light sources arranged at 90-degree intervals around a circle concentric with the inspection area and in a plane parallel to that of the inspection area, at a height which will allow incident light to fall on the centre of the inspection area at an angle of 45° to its plane, and

— a light collection device, the optical axis of which is perpendicular to the inspection area and passes through its centre, and which focuses an image of the test symbol on a light-sensitive array.

The light reflected from the inspection area shall be collected and focused on the light-sensitive array.

Implementations may use alternative optical geometries and components, provided that their performance can be correlated with that of the reference optical arrangement defined in this subclause. Figure 1 and Figure 2 illustrate the principle of the optical arrangement, but are not intended to represent actual devices; in particular, the magnification of the device is likely to differ from 1:1. For example, it is possible to use a 10 MP industrial camera without IR cut filter with a sensor size of ½". The image could be captured from a distance of approximately 350 mm and the lens chosen appropriately. The resulting magnification then would be 1:21.



Key

1 light-sensing element

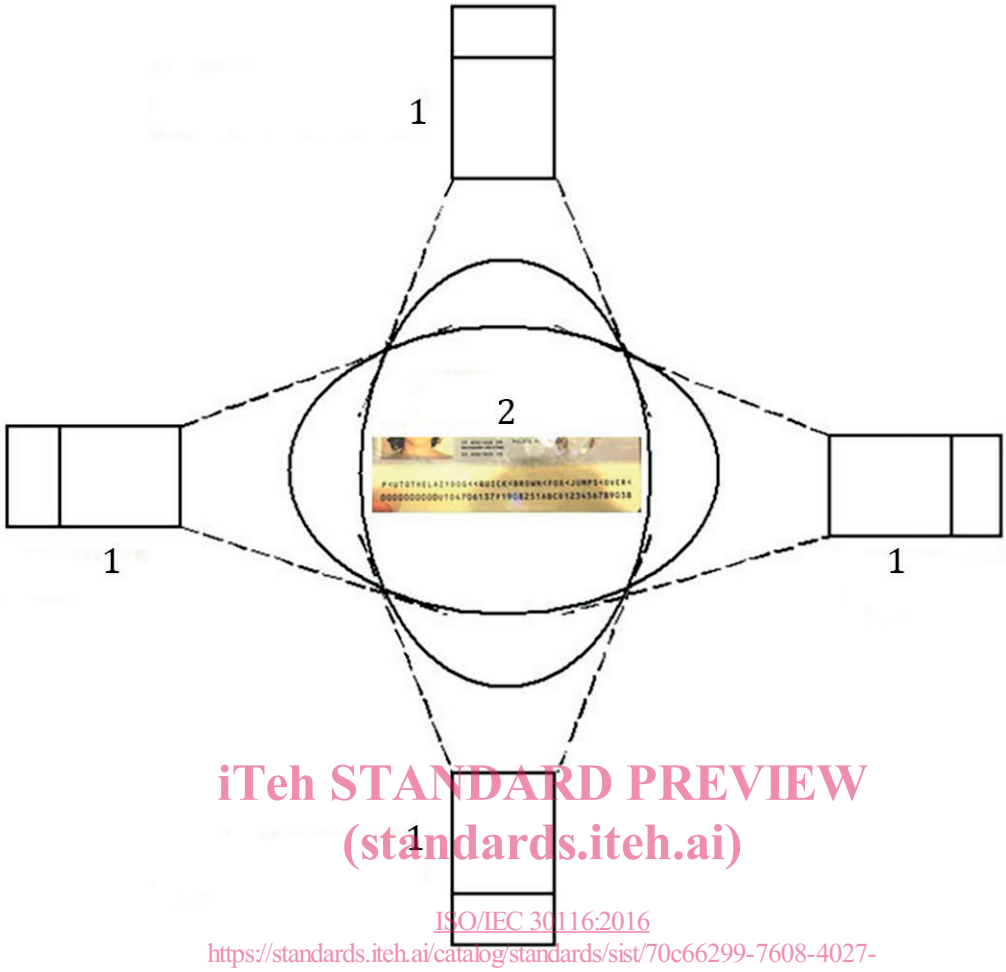
2 lens providing 1:1 magnification (measurement A = measurement B)

3 inspection area

4 light sources

ϑ angle of incidence of light relative to plane of symbol = 45°

Figure 1 — Reference optical arrangement — Side view



Key

1 light source
2 symbol

Figure 2 — Reference optical arrangement — Top view