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Information technology, Automatic identification and data capture techniques — Bar code symbol print quality test specification — Two-dimensional symbols

Technologies de l'information, Informatique, Techniques d'identification et de saisie de données automatiques — Spécification de test de qualité d'impression des symboles de code à barres — Symboles bi-dimensionnels

Third edition

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Contents

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. ~~In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1.~~

~~International Standards~~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 ~~given in~~of the ISO/IEC Directives, Part 2 (see www.iso.org/directives or www.iec.ch/members_experts/refdocs~~.~~).

~~The main task of the joint technical committee is to prepare International Standards. 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.~~

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For an explanation of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards~~ISO/IEC 15415~~.

This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

This third edition cancels and replaces the second edition (ISO/IEC 15415:2011) which has been technically revised.

The main changes ~~compared to the previous edition~~ are as follows:

- ~~introduction of~~— a continuous (or decimal) grading has been introduced;
- ~~introduction of~~ — a more optimal threshold calculation has been introduced;
- ~~introduction of~~ — a more stable symbol contrast calculation has been introduced;
- — a definition of grading for print growth has been added;

- — combination of modulation and reflectance margin into a single measurement.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

The technology of bar coding is based on the recognition of patterns encoded, in bars and spaces or in a matrix of modules of defined dimensions, according to rules defining the translation of characters into such patterns, known as the symbology specification. Symbology specifications may be categorised into those for linear symbols, on the one hand, and two-dimensional symbols on the other; the latter may in turn be ~~sub-divided~~subdivided into "multi-row bar code symbols" sometimes referred to as "stacked bar code symbols", and "two-dimensional matrix symbols". In addition, there is a hybrid group of symbologies known as "composite symbologies"; these symbols consist of two components carrying a single message or related data, one of which is usually a linear symbol and the other a two-dimensional symbol positioned in a defined relationship with the linear symbol.

Multi-row bar code symbols are constructed graphically as a series of rows of symbol characters, representing data and overhead components, placed in a defined vertical arrangement to form a (normally) rectangular symbol, which contains a single data message. Each symbol character has the characteristics of a linear bar code symbol character and each row has those of a linear bar code symbol; each row, therefore, may be read by linear symbol scanning techniques, but the data from all the rows in the symbol must be read before the message can be transferred to the application software.

Two-dimensional matrix symbols are normally square or rectangular arrangements of dark and light modules, the centres of which are placed at the intersections of a grid of two (sometimes more) axes; the coordinates of each module need to be known in order to determine its significance, and the symbol must therefore be analysed two-dimensionally before it can be decoded. Some matrix codes are comprised of unconnected dots, in which the individual modules do not directly touch their neighbours but are separated from them by a clear space.

Unless ~~the context requires~~explicitly specified otherwise, the term "symbol" in this document ~~may refer~~refers to either type of symbology.

The bar code symbol must be produced in such a way as to be reliably decoded at the point of use, if it is to fulfil its basic objective as a machine-readable data carrier.

Manufacturers of bar code equipment and the producers and users of bar code symbols therefore require publicly available standard test specifications for the objective assessment of the quality of bar code symbols ~~(~~, a process known as verification~~)~~, to which they can refer when developing equipment and application specifications or determining the quality of the symbols. Such test specifications form the basis for the development of measuring equipment for process control and quality assurance purposes during symbol production as well as afterwards.

The performance of measuring equipment for the verification of symbols ~~(~~, also known as verifiers~~)~~, is ~~the subject of a separate document (~~covered in ISO/IEC 15426~~, Parts~~ 1 and ISO/IEC 15426-2~~)~~.

The methodology described in this document is intended to achieve comparable results to the linear bar code symbol quality standard ISO/IEC 15416, the general principles of which ~~it~~this document has followed. It should be read in conjunction with the symbology specification applicable to the bar code symbol being tested, which provides symbology-specific ~~detail~~details necessary for its application. Two-dimensional multi-row bar code symbols are verified according to the ISO/IEC 15416 methodology, with the modifications described in Clause 6; different parameters and methodologies are applicable to two-dimensional matrix symbols. The procedures described in this document must necessarily be augmented by the reference decode algorithm and other measurement details within the applicable symbology specification, and they may also be altered or overridden as appropriate by governing symbology or application specifications.

The method of quality assessment described in this document is most applicable to reading environments wherein printed and otherwise marked symbols are read predominantly by diffuse reflection. For direct part mark applications, in which symbols and substrates may be glossy, specular, low contrast, etc., a modified

and extended version of the methodology defined in this document has been defined in ISO/IEC 29158 and provides for lighting arrangements and enhanced algorithms which more closely match reading equipment commonly used in DPM applications.

NOTE The Bibliography provides official and industry standards containing symbology specifications, among other references, to which this document applies. However, the Bibliography does not provide an exhaustive list of symbology specifications.

Information technology, Automatic identification and data capture techniques — Bar code symbol print quality test specification — Two-dimensional symbols

1 Scope

This document

— specifies two methodologies for the measurement of specific attributes of two-dimensional bar code symbols~~, –~~ one of ~~these being applicable~~which applies to multi-row bar code symbologies and the other to two-dimensional matrix symbologies;

— ~~defines~~specifies methods for evaluating and grading these measurements and deriving an overall assessment of symbol quality;

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

This document applies to ~~those~~ two-dimensional symbologies for which a reference decode algorithm has been defined, ~~but its~~however the methodologies in this document can be applied partially or wholly to other similar symbologies.

NOTE While this document ~~may~~can be applied to direct part marks, ~~it is possible that~~ better correlation between measurement results and scanning performance ~~will~~can be obtained with ISO/IEC 29158 in combination with this document.

2 Normative references

The following ~~referenced~~ documents are ~~indispensable for~~referred to in the ~~application~~text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 19762, *Information technology — Automatic identification and data capture (AIDC) techniques — Harmonized vocabulary*

ISO/IEC 15416, *Information technology – Automatic identification and data capture techniques — Bar code print quality test specification — Linear symbols*

ISO/IEC 15426-2, *Information technology — Automatic identification and data capture techniques — Bar code verifier conformance specification — Part 2: Two-dimensional symbols*

NOTE The Bibliography lists official and industry standards containing specifications of symbologies to which (inter alia) this document is applicable.

3 Terms and definitions

For the purposepurposes of this document, the terms and definitions given in ISO/IEC 19762, ISO/IEC 15416 and the following apply.

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

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

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

3.1
binarised image
binary (black/white) image created by applying a threshold to the *pixel* (3.7) values in the *reference grey-scale image*. (3.9)

3.2
effective resolution
resolution obtained on the surface of the symbol under test, normally expressed in pixels per mm or pixels per inch, and calculated as the resolution of the image capture element multiplied by the magnification of the optical elements of the measuring device.

Note 1 to entry: The effective resolution is normally expressed in *pixels* (3.7) per mm (or pixels per inch).

3.3
error correction capacity
number of codewords, or units of data, in a symbol (or error control block) assigned for erasure and error correction, minus the amount reserved for error detection.

3.4
inspection area
portion of an image which contains the entire symbol to be tested inclusive of its quiet zones.

3.5
grade threshold
boundary value separating two grade levels, the value itself being taken as the lower limit of the upper grade.

3.6
module error
module of which the apparent dark or light state in the *binarised image* (3.1) is inverted from its intended state.

3.7
pixel
individual light-sensitive element in an array, e.g.,

EXAMPLE CCD (charge coupled device) or), CMOS (complementary metal oxide semiconductor) device.

3.8
raw image
plot of the reflectance values in x and y coordinates across a two-dimensional image, representing the discrete reflectance values from each *pixel* (3.7) of the light-sensitive array~~.~~

3.9
reference grey-scale image
plot of the reflectance values in x and y coordinates across a two-dimensional image, derived from the discrete reflectance values of each *pixel* (3.7) of the light-sensitive array by convolving the *raw image* (3.8) with a *synthesised aperture*~~.~~ (3.10)

3.10
synthesised aperture
convolutional kernel used to blur an image

4 Symbols ~~(~~and abbreviated terms~~)~~

4.1 Symbols

~~The following symbols are used in this document.~~

~~**4.1.1 E_{cap}**~~

~~Error correction capacity of the symbol~~

~~**4.1.2 D**~~

~~Distance across, or with of an element in a symbol~~

~~**4.1.3 D_{NOM}**~~

~~Expected, or nominal, width of an element in a symbol~~

~~**4.1.4 e**~~

~~number of erasures~~

~~**4.1.5 M_{MOD}**~~

~~a measure of the difference in reflectance between a module and the threshold~~

~~**4.1.6 M_{ANU}**~~

~~A measure of axial nonuniformity~~

~~4.1.7 M_{GNU}~~

~~A measure of grid nonuniformity~~

~~4.1.8 M_{UEC}~~

~~A measure of unused error correction taking into account the number of errors, erasures and capacity~~

~~4.1.9 R~~

~~reflectance~~

~~4.1.10 R_{max}~~

~~reflectance value indicative of the brightest area of a symbol~~

~~4.1.11 R_{min}~~

~~reflectance value indicative of the darkest area of a symbol~~

~~4.1.12 ΔR_{SC}~~

~~Symbol contrast, the difference in reflectivity between R_{max} and R_{min}~~

~~4.1.13 t~~

~~number of errors~~

~~4.1.14 T~~

~~Threshold~~

~~4.1.15 X_{AVG}~~

~~The average spacing of modules in the horizontal axis~~

~~4.1.16 Y_{AVG}~~

~~The average spacing of modules in the vertical axis~~

E_{cap} error correction capacity of the symbol

D distance across or width of an element in a symbol

D_{NOM} expected or nominal width of an element in a symbol

e number of erasures

M_{MOD} measure of the difference in reflectance between a module and the threshold

M_{ANU} measure of axial nonuniformity

M_{GNU} measure of grid nonuniformity

M_{UEC} measure of unused error correction, accounting for the number of errors, erasures and capacity

R reflectance

R_{max} indicative reflectance of the brightest area of a symbol