INTERNATIONAL STANDARD

ISO/IEC 15416

Second edition
2016-12-15

Automatic identification and data capture techniques — Bar code print quality test specification — Linear symbols

Techniques automatiques d'identification et de capture des données — Spécifications pour essai de qualité d'impression des codes à barres — Symboles linéaires

Reference number
ISO/IEC 15416:2016(E)

Contents

Page

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.

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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC 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/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

This second edition cancels and replaces the first edition (ISO/IEC 15416:2000), which has been technically revised with the following changes, as well as minor editorial modifications:

— the computation of "Defects" was modified in this revision of ISO/IEC 15416 (see Note 3 in 5.4.8); and

— sharp boundaries between grade levels are avoided by assigning grades within grade boundaries to the first decimal place (see the Notes in 6.2.2 and 6.2.3).

Introduction

The technology of bar coding is based on the recognition of patterns encoded in bars and spaces of defined dimensions according to rules defining the translation of characters into such patterns, known as the symbology specification.

The bar code symbol is 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, to which they can refer to when developing equipment and application standards 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 is the subject of a separate standard, ISO/IEC 15426-1.

This document is to be read in conjunction with the symbology specification applicable to the bar code symbol being tested, which provides symbology-specific detail necessary for its application.

This methodology provides symbol producers and their trading partners a universally standardized means for communicating about the quality of bar code symbols after they have been printed.

Automatic identification and data capture techniques — Bar code print quality test specification — Linear symbols

1 Scope

This document:

— specifies the methodology for the measurement of specific attributes of bar code symbols;

— defines a method for evaluating these measurements and deriving an overall assessment of symbol quality; and

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

This document applies to those symbologies for which a reference decode algorithm has been defined, and which are intended to be read using linear scanning methods, but its methodology can be applied partially or wholly to other symbologies.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762 and the following 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
bar reflectance
lowest reflectance value in the scan reflectance profile of a bar element

3.2
decode
determination of the information encoded in a bar code symbol

3.3
edge contrast
difference between *bar reflectance* (3.1) and *space reflectance* (3.14) of two adjacent elements

3.4
element reflectance non-uniformity
reflectance difference between the highest *peak* (3.9) and the lowest *valley* (3.16) in the scan reflectance profile of an individual element or quiet zone

3.5
global threshold
reflectance level midway between the maximum and minimum reflectance values in a scan reflectance profile used for the initial identification of elements

3.6
inspection band
band (usually from 10 % to 90 % of the height of a bar code symbol) across which measurements are taken

Note 1 to entry: See Figure 2.

3.7
measuring aperture
opening which governs the effective *sample area* (3.10) of the symbol, and the dimensions of which at 1:1 magnification is equal to that of the sample area

3.8
modulation
ratio of minimum *edge contrast* (3.3) to *symbol contrast* (3.15)

3.9
peak
point of higher reflectance in a scan reflectance profile with points of lower reflectance on either side

3.10
sample area
effective area of the symbol within the field of view of the measurement device

3.11
scan path
line along which the centre of the *sample area* (3.10) traverses the symbol, including quiet zones

3.12
show-through
property of a substrate that allows underlying markings or materials to affect the reflectance of the substrate

3.13
space
light element corresponding to a region of a scan reflectance profile above the *global threshold* (3.5)

3.14
space reflectance
highest reflectance value in the scan reflectance profile of a space element or quiet zone

3.15
symbol contrast
difference between the maximum and minimum reflectance values in a scan reflectance profile

3.16
valley
point of lower reflectance in a scan reflectance profile with points of higher reflectance on either side

4 Symbols and abbreviated terms

4.1 Abbreviated terms

EC	edge contrast
EC_{min}	minimum value of EC
ERN	element reflectance non-uniformity
ERN_{max}	maximum value of ERN

GT global threshold

MOD modulation

PCS print contrast signal

RT reference threshold

SC symbol contrast

4.2 Symbols

A average achieved width of element or element combinations of a particular type

c defect adjustment constant

e width of widest narrow element

E width of narrowest wide element

e_i i'th edge to similar edge measurement, counting from leading edge of symbol character

F factor used to soften the effect on defect grades derived from small changes peaks and valleys within an element

K smallest absolute difference between a measurement and a reference threshold

k number of element pairs in a symbol character in a (n, k) symbology

M width of element showing greatest deviation from A

m number of modules in a symbol character

N average achieved wide to narrow ratio

n number of modules in a symbol character in a (n, k) symbology

R_b bar reflectance

R_D dark reflectance

R_L light reflectance

R_{max} maximum reflectance

R_{min} minimum reflectance

R_s space reflectance

RT_j reference threshold between measurements j and (j + 1) modules wide

S total width of a character

V decodability value

V_C decodability value for a symbol character

Z average achieved narrow element dimension or module size, as measured

5 Measurement methodology

5.1 General requirements

The measurement methodology defined in this document is designed to maximize the consistency of both reflectivity and bar and space width measurements of bar code symbols on various substrates. This methodology is also intended to correlate with conditions encountered in bar code scanning hardware.

Measurements shall be made with a defined light source (such as a single light wavelength) and a measuring aperture of dimensions defined by the application specification or determined in accordance with 5.2.1 and 5.2.2. A circular aperture is defined by its diameter in accordance with Table 1. Application specifications may define other aperture diameters or shapes.

Whenever possible, measurements shall be made on the bar code symbol in its final configuration, i.e. the configuration in which it is intended to be scanned. If this is impossible, refer to Annex C for the method to be used for measuring reflectance for non-opaque substrates.

The sampling method should be based on a statistically valid sample size within the lot or batch being tested. A minimum grade for acceptability shall be established prior to quality control inspection. In the absence of a sampling plan defined in formal quality assurance procedures or by bilateral agreement, a suitable plan may be based on the recommendations in ISO 2859-1.

5.2 Reference reflectivity measurements

5.2.1 General

Equipment for assessing the quality of bar code symbols in accordance with this document shall comprise a means of measuring and analysing the variations in the diffuse reflectivity of a bar code symbol on its substrate along a number of scan paths which shall traverse the full width of the symbol including both quiet zones. The basis of this methodology is the measurement of diffuse reflectance from the symbol.

All measurements on a bar code symbol shall be made within the inspection band defined in accordance with 5.2.4.

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

5.2.2 Measurement light source

The light source used for measurements should be specified in the application specification to suit the intended scanning environment. When the light source is not specified in the application specification, measurements should be made using the light source that approximates most closely to the light source expected to be used in the scanning process. Light sources may include narrow band or broad band illumination. Refer to Annex E for guidance on the selection of the light source.

5.2.3 Measuring aperture

The nominal diameter of the measuring aperture should be specified by the user application specification to suit the intended scanning environment. When the measuring aperture diameter is not specified in the application specification, Table 1 should be used as a guide. In an application where a range of X dimensions will be encountered, all measurements shall be made with the aperture appropriate to the smallest X dimension to be encountered.

In the absence of a defined X dimension, the Z dimension shall be substituted.

The effective measuring aperture diameter may vary slightly from its nominal dimension due to manufacturing tolerances and optical effects. Note that the measured width of some of the narrow elements may be smaller than the measuring aperture diameter.

Table 1 — Guideline for diameter of measuring aperture

X Dimension (mm)	**Aperture diameter** (mm)	**Reference number**
0,100 ≤ X < 0,180	0,075	03
0,180 ≤ X < 0,330	0,125	05
0,330 ≤ X < 0,635	0,250	10
0,635 < X	0,500	20
NOTE The aperture reference number approximates to the measuring aperture diameter in thousandths of an inch.		

NOTE The measuring aperture is not to be confused with the F-number of a lens.

5.2.4 Optical geometry

The reference optical geometry for reflectivity measurements shall consist of the following:

a) a source of incident illumination which is uniform across the sample area at 45° from a perpendicular to the surface, and in a plane containing the illumination source that shall be both perpendicular to the surface and parallel to the bars;

b) a light collection device, the axis of which is perpendicular to the surface.

The light reflected from a circular sample area of the surface shall be collected within a cone; the angle at the vertex of which is 15°, centred on the perpendicular to the surface, through a circular measuring aperture, the diameter of which at 1:1 magnification shall be equivalent to that of the sample area.

NOTE Figure 1 illustrates the principle of the optical arrangement, but is not intended to represent an actual device.

This reference geometry is intended to minimize the effects of specular reflection and to maximize those of diffuse reflection from the symbol. It is intended to provide a reference basis to assist the consistency of measurement. It may not correspond with the optical geometry of individual scanning systems. Alternative optical geometries and components may be used, provided that their performance can be correlated with that of the reference optical arrangement defined in this subclause.