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Information technology – Automatic identification and data capture techniques – Bar code printer and bar code reader performance testing specification

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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.

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 or www.iec.ch/members_experts/refdocs).

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

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.

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

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

Bar code printers and bar code readers are key equipment in auto-ID systems. However, manufacturers of this equipment evaluate their products' performance by their own test methods and measures, specifying this performance in their catalogues. As a result, actual performance varies, although there are some performance values that are the same across catalogues. Therefore, users are forced to test the equipment in order to find the most suitable solutions for their applications, at their own cost.

This document was developed to provide standard test and ranking methods giving users a **common ruler** to be able to evaluate performance values in selecting equipment to meet their needs.

Furthermore, this document is expected to be used in avoiding using poor quality products.

NOTE There are ISO/IEC 15419 and ISO/IEC 15423. ISO/IEC 15419 mainly specifies how to print a barcode as a digital image, so that the contents focus on software development and look like a technical suggestion with no details on how to evaluate performances of a bar code printer in total.

This document specifies more details how to test and evaluate complete printer performances including durability of printed labels.

ISO/IEC 15423 is made based on that a scanner and a decoder are separated devices, which is a quite old fashion system. Although, a combination case of a scanner and a decoder is mentioned.

This document specifies more details how to test and evaluate reader performances, which covers test items specified in ISO/IEC 15423.

Information technology – Automatic identification and data capture techniques – Bar code printer and bar code reader performance testing specification

1 Scope

This document specifies the performance evaluation specifications of thermal transfer type printers (hereinafter referred to as bar code printers), consumables, and bar code readers (regardless of the reading method) used in bar code systems. The rank of performance is also defined by the evaluation items.

This document can be applied to the following evaluation tests by combining ISO/IEC 15416 and ISO/IEC 15415, which define the print qualities of bar code symbols.

NOTE This document is not prevented from being cited in the evaluation of thermal printers using thermal paper and printers using "plain or exclusive paper" (commercial printing, ink jet printers, electrophotographic printers, etc.).

a) Print performance of bar code printers (including consumables)

b) Brightness and smoothness of "reception paper or label", and adhesion of the label

c) Strength of reception paper or label on which the bar code is printed

d) Reading performance of bar code readers

e) Electrical, mechanical and environmental characteristics of bar code printers and bar code readers

2 Normative references

The following documents are referred to in the 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 105-A03, *Textiles — Tests for colour fastness — Part A03: Grey scale for assessing staining*

ISO 105-C06, *Textiles — Tests for colour fastness — Part C06: Colour fastness to domestic and commercial laundering*

ISO 105-F09, *Textiles — Tests for colour fastness — Part F09: Specification for cotton rubbing cloth*

ISO 105-X11, *Textiles — Tests for colour fastness — Part X11: Colour fastness to hot pressing*

ISO 105-X12, *Textiles — Tests for colour fastness — Part X12: Colour fastness to rubbing*

ISO 2470-1, *Paper, board and pulps — Measurement of diffuse blue reflectance factor — Part 1: Indoor daylight conditions (ISO brightness)*

ISO 29862, *Self adhesive tapes — Determination of peel adhesion properties*

ISO 6353-2, *Reagents for chemical analysis — Part 2: Specifications — First series*

ISO 8791-5, *Paper and board — Determination of roughness/smoothness (air leak methods) — Part 5: Oken method*

ISO/IEC 15426-1, *Information technology — Automatic identification and data capture techniques — Bar code verifier conformance specification — Part 1: Linear symbols*

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

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

ISO/IEC 60068-2-1, *Environmental testing — Part 2-1: Tests — Test A: Cold*

ISO/IEC 60068-2-6, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal)*

ISO/IEC 60068-2-78, *Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state*

ISO/IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

ISO/IEC 61000-4-2, *Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*

ISO/IEC 61000-4-3, *Electromagnetic compatibility (EMC) — Part 4-3: Testing and measurement techniques — Radiated, radio-frequency, electromagnetic field immunity test*

ISO/IEC 61000-4-4, *Electromagnetic compatibility (EMC) — Part 4-4: Testing and measurement techniques — Electrical fast transient/burst immunity test*

IEC CISPR 32, *Electromagnetic compatibility of multimedia equipment — Emission requirements*

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in ISO/IEC 19762, 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 Terms and definitions

3.1.1
adhesion characteristics
clinging performance of a label attached to a base material to be adhered.

3.1.2
brightness
degree of whiteness of the print surface of the reception paper or label.

3.1.3
ceramic label
label in which a bar code symbol is printed on the surface of a raw ceramic material before-burning, and then is burned to form a ceramic.

3.1.4
consumables
reception papers, labels and ribbons that shall be refilled by the user as needed.

3.1.5
fixed mount reader
bar code reader (also called a stationary reader) that is fixed to specific locations.

3.1.6
label
reception paper having an adhesive applied to the back surface thereof.

3.1.7
ladder type print
print state in which the height direction of the bar is perpendicular to the movement direction of the medium to be printed.

3.1.8
lateral motion reading speed
maximum speed at which a one-dimensional symbol can be read while the symbol or the bar code reader is moving in a direction perpendicular to the elements of symbols.

3.1.9
nominal dpi
number of dots per inch, rounded to be conventionally an integral number, multiplied by 25,4 times the number of dots per mm.

3.1.10
performance rank
ranking for performance of each evaluation item.

3.1.11
picket fence print
print state in which the height direction of the bar is in the horizontal direction with respect to the movement direction of the medium to be printed.

3.1.12
print
transfer ink from a ribbon to a reception paper or a label using a thermal transfer printer and represent a bar code, etc.

3.1.13
printing
press a bar code using a plate and ink.

3.1.14
reception paper
paper or film having an ink receptible layer.

3.1.15
release liner
paper or film (also referred to as backing paper) having a surface processed to be anti-adhesive.

3.1.16
ribbon
roll of hot-melt ink applied to one side of a film.

3.1.17
smoothness
degree of the flatness of a reception paper or label surface.

3.1.18
test chart
high-precision bar code symbol printed on a photo paper for use in the reading performance test of bar code readers.

3.1.19
thermal print head
electronic component having a structure in which a multiple of minute heating resistors are linearly arranged, and which works to apply heat to a ribbon.

3.1.20
thermal transfer printer and bar code printer
equipment that incorporates a function of converting data into a bar code image and transfers ink from a ribbon using heat (by any method of thermal transfer) to the image.

3.2 Symbols

In this document, unless otherwise specified, the following symbols are used:

AV Variation of read time between print quality grades in axial non-uniformity test

B Number of bends in the interface cable strength test

BRPT Test charts for bar code reader performance tests

DCV Variation of reading time between print quality grades in decoding facility test

DOF Reading depth when bar code reader reads symbol (depth of field)

DV Variation of read time between print quality grades in defect test

F Smoothness of the reception paper

FV Variation of read time between print quality grades in fixed pattern damage test

GV Variation of read time between print quality grades in grid non-uniformity test

H Fall distance in non-pack drop test

L Maximum illuminance in the ambient illuminance test

Ms Moving speed of the moving object reading speed test

MV Variation of read time between print quality grades in modulation test

N Number of depressions in the trigger switch endurance test

PSmax Maximum print speed

Re Minimum print resolution

RT Value obtained by dividing the reading time in the reading speed test by the number of readings (100)

RTV Time obtained by subtracting the minimum reading time from the maximum reading time in the symbol contrast test

T Time to print 50 consecutive sets of standard images

Tmps The value obtained by dividing T by 50 when consecutive sets of standard images were printed with print quality overall grade 1,5 or a value more than but close to 1,5

UV Variation of read Time between print quality grades in unused error correction capacity test

Va Electrostatic strength in the air discharge test

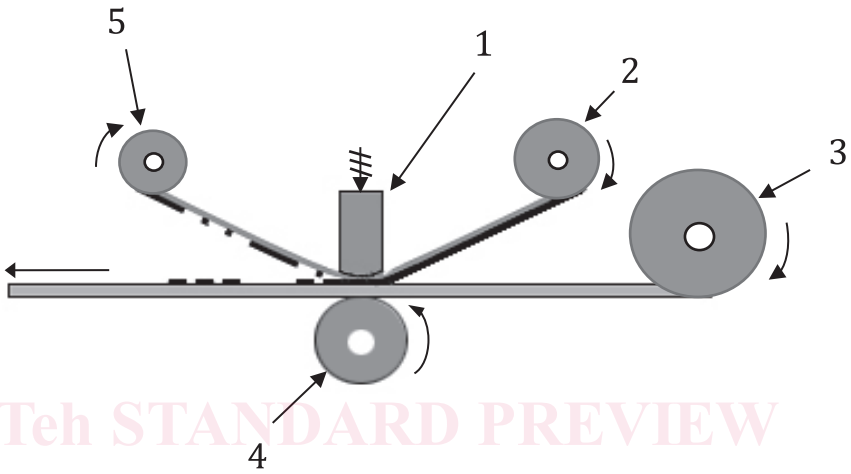
Vc Electrostatic strength in contact discharge test

4 Bar code printer and consumables

4.1 Bar code printer

4.1.1 General requirements

Basic print-mechanism of a general thermal transfer printer is shown in Figure 1.



Key

1 thermal print head
2 ribbon (unwinding)
3 reception paper of label roles (supplying)
4 platen roller
5 ribbon (winding)

Figure 1 — Basic print mechanism of thermal transfer printer

As shown in Figure 1, a "reception paper or label" and a ribbon are passed between the platen roller and the thermal print head, and the thermal print head is normally pressed down and secured to provide the appropriate print pressure. As the platen roller rotates in the direction of the arrow, the "reception paper or label" and ribbon move in the transport direction. In synchronism with this movement, the ink on the ribbon is melted by heating the heating elements of the thermal print head and transferred to the “reception paper or label”. At this time, the heating element that heats is only an element corresponding to the image to be printed.

Print condition setting and environmental conditions are as follows.

a) Print condition setting on thermal transfer printer to be evaluated

It is desirable that a thermal transfer printer to be evaluated in this document is set to a condition estimated to be optimal for the "reception paper or label" and the ribbon used in the test. This print setting serves to maximize the print performance of the bar code printer to be evaluated.

NOTE In the thermal transfer type, it is known that the print quality varies depending on the combination of the "reception paper or label" and the ribbon.

b) Ambient environment conditions

For bar code printers in which ink is melted by heat and transferred to a “reception paper or label”, ambient temperature affects print quality, but also thermal conductivity, specific heat capacity, etc. of the “reception paper or label”, the ribbon, the platen, etc. affect print quality. Also, condensation on the thermal print head may cause failure. In order to print bar codes while maintaining high print quality, precaution shall be paid to the surrounding environment.

Performance tests of bar code printers shall be performed under the following environmental conditions. However, when the environmental conditions are individually stipulated in each performance evaluation test item, or when there is a quote standard in each evaluation test item, the stipulations or standard shall be given priority. In addition, during tests, the temperature and/or humidity shall not be abruptly changed to conditions where condensation occurs.

— temperature : 18 °C to 28 °C

— humidity : 30 % Rh to 70 % Rh

— Before starting the performance evaluation tests, the main body of the bar code printer (non-energization), the "reception paper or label" and the ribbon used for the tests shall be left in the above-mentioned temperature and humidity environment for at least 6 h.

Ambient environmental conditions at the time of the tests shall be recorded in the test result report of 4.3 together with the test results.

4.1.2 Performance evaluation items and test methods

4.1.2.1 Standard image for evaluation of printer performance tests

Standard images for evaluation of printer performance (hereinafter referred to as standard images) shall be used and evaluated under the specified conditions.

The standard image is based on BCP-nnn-1 (nnn is nominal dpi; the same applies hereinafter) and BCP-nnn-2 (see Figure 2), and the combination shown in Figure 4 is set in accordance with the width of the reception paper or label. The standard image has the following features (see Annex A).

— One-dimensional and two-dimensional symbols for evaluating bar code print quality

— Corner marks (see Figure 5) that help to visually determine print quality

— Image pattern to use all of the heating elements that enables failure detection of the thermal printhead heating elements

— 90 degrees rotated bar code for knowing the quality of print in ladder type and in picket fence type

— Strings to determine the legibility of small characters

— Counter for counting the number of prints (one set)

— Logo mark may be printed in image mode (see A.2)

The corner mark shall use the bitmap image defined in A.1.1. The other images shall be created by a dedicated commands of the bar code printer to be evaluated. The positions at which the one-dimensional symbols and the two-dimensional symbols are printed are based on the arrangement shown in Figure 2, but the base points of each symbol are not defined. However, it shall not be arranged so as to infringe the quiet zone of the symbol.

The size of BCP-nnn-1 and BCP-nnn-2 is 50,8 mm × 76,2 mm (2 inches × 3 inches), which can be used in conjunction for nominal 200, 300, 400 and 600 dpi bar code printers commonly used for “reception papers or labels” of 50,4 mm (2 inches) to 203,2 mm (8 inches) wide and 254,0 mm (10 inches) wide (see Figure 4).

NOTE 1 dpi is the resolution and the number of dots per inch (1 inch is 25,4 mm).

NOTE 2 The standard image is mainly used to evaluate the maximum print speed, the minimum print resolution, the suitability of the reception paper or label with the ribbon, and the like.

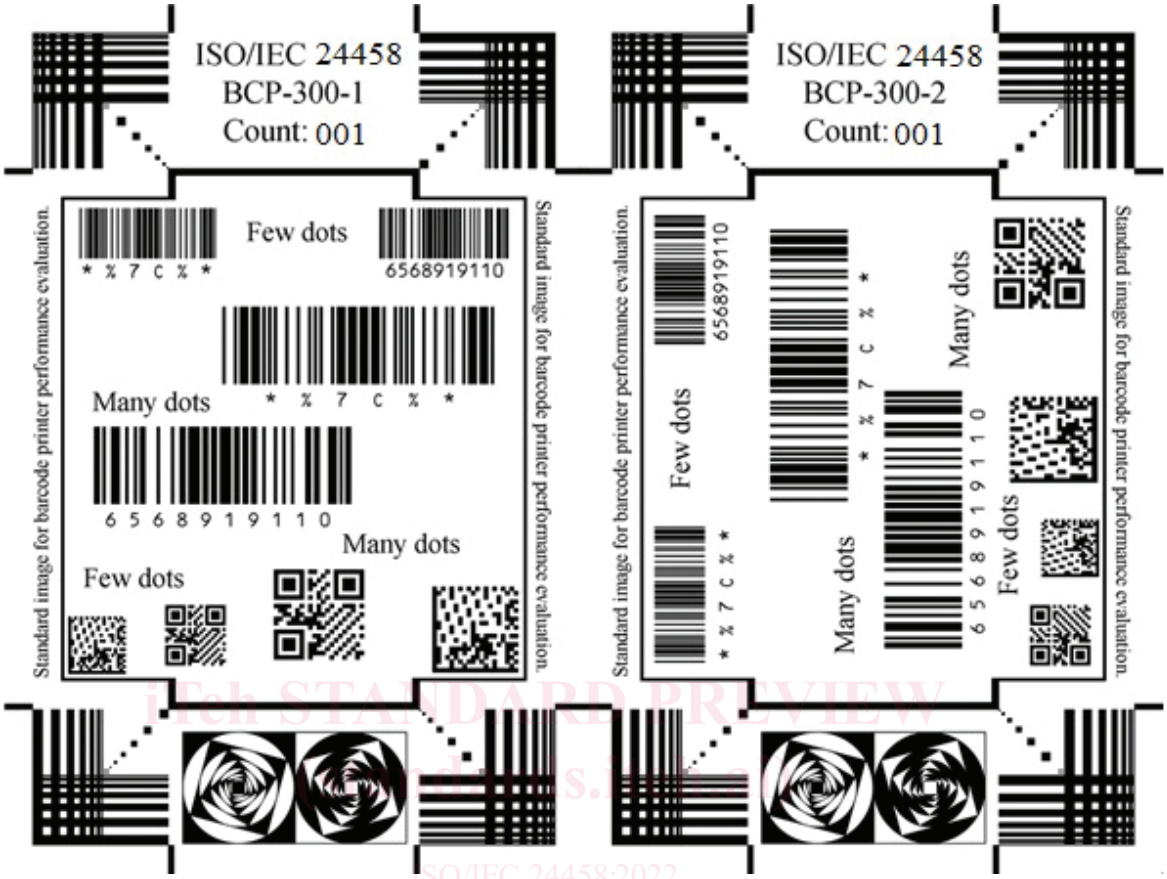


Figure 2 — Example of individual image arrangement of standard image for evaluation of performance of bar code printer

— The International Standard number ("ISO/IEC 24458"), standard image number ("BCP-300-1" and "BCP-300-2"), number count ("count:001") and "Standard image for bar code printer performance evaluation." displayed on the standard image shall be selected from the fonts and sizes built into the barcode printer.

NOTE 3 Font and size are taken into account so as not to break the overall balance.

— As the frame line width surrounding the bar code symbol, the numbers of dots constituting the minimum element (many dots) of the one-dimensional symbol are used (see Table 1).

— The value of the number-of-sheets count is printed on anyone (or all) of the standard images in the set of standard images defined in Figure 4. Table 1 shows the number of dots constituting the minimum elements of the one-dimensional symbol and the two-dimensional symbol according to dpi of the bar code printer.

Table 1 — Number of dots making up the minimum element at nominal dpi

Nominal dpi	One-dimensional symbol		Two-dimensional symbol	
	Few dots	Many dots	Few dots	Many dots
180	1(0,143 mm)	2(0,286 mm)	2(0,286 mm)	3(0,429 mm)
200	1(0,125 mm)	2(0,250 mm)	2(0,250 mm)	3(0,375 mm)
NOTE Numbers in parentheses are reference values obtained by converting the number of dots into mm.				

Table 1 *(continued)*

Nominal dpi	One-dimensional symbol		Two-dimensional symbol	
	Few dots	Many dots	Few dots	Many dots
300	2(0,167 mm)	3(0,250 mm)	3(0,250 mm)	4(0,333 mm)
360	2(0,143 mm)	3(0,214 mm)	3(0,214 mm)	5(0,357 mm)
400	2(0,125 mm)	4(0,250 mm)	3(0,188 mm)	6(0,375 mm)
600	2(0,083 mm)	6(0,250 mm)	3(0,125 mm)	8(0,333 mm)
NOTE Numbers in parentheses are reference values obtained by converting the number of dots into mm.				

The specifications of the one-dimensional symbol and the two-dimensional symbol to be printed with the standard image are shown in Table 2.

Table 2 — Specifications of bar codes printed in standard Image

Item	Code 39 (See ISO/ IEC 16388)	Code 128 (See ISO/IEC 15417)	Data matrix (See ISO/IEC 16022)	QR code (See ISO/ IEC 18004)
Data	*%7C%*	STC 65 68 91 91 10	40 "0"s	41 "0"s
Narrow/wide ratio (N)	1:3	—	—	—
Intercharacter gap	1X	—	—	—
Check character	None	66(STX)	—	—
Bar height (Regardless with few dots or many dots bar width)			—	—
(180 dpi)[a]	[35 dots (approx.5 mm) or more]			
200 dpi	40 dots (approx.5 mm) or more			
300 dpi	60 dots (approx.5 mm) or more			
(360 dpi)[a]	[70 dots (approx.5 mm) or more]			
400 dpi	80 dots (approx.5 mm) or more			
600 dpi	120 dots (approx.5 mm) or more			
Symbol size and error correction level	-	-	20 x 20 automatic	21 x 21 L
Readable characters and points	OCR B not specified	OCR B not specified	None	None
NOTE The first "STC" in the data of the code 128 represents the start C.				
[a] The bar height can vary because a “reception paper or label” less than 50,8 mm (2 inches) wide can be improperly printed.				

The print combination of the standard image according to the “reception paper or label” width is according to Figure 4. The downward arrow is the direction of transportation of the "reception paper or label" and the ribbon. In Figure 4, the 127,0 mm (5 inches) wide and the 177,8 mm (7 inches) wide are printed by providing blanks of 25,4 mm (1 in) (if there are changes in the 127,0 mm (5 inches) width and the 177,8 mm (7 inches) width, provide appropriate blanks) between BCP-nnn-1 and BCP-nnn-2. At this time, the two protruding lines of the opposed corner marks shall be extended and connected. The “reception paper or label” and the ribbon shall be of a size sufficient to print a standard image.

Bar code printers that use a “reception paper or label” other than the width shown in Figure 4, for example, in the form of a tape less than 50,8 mm (2 inches) wide, may relocate the elementary images

that make up the standard image and print them side-by-side in series. In this case, print may be performed in the following manner.

— Four corner marks (without two outwardly protruding bars)

— Code 39 changed to the number of printable dots and the number of printable characters

— Printable two-dimensional symbols in Table 2 (sufficient quiet zones shall be provided)

— ISO/IEC number

— Standard image number

— Count the number of sheets

Further, the symbols to be verified for the bar code print quality may be evaluated only by the symbols that have been printed.

An example of using a tape-like reception paper or label less than 2 inches wide is shown in Figure 3.

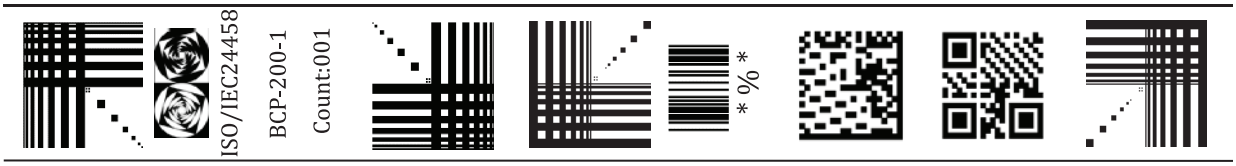


Figure 3 — Example of standard image arrangement for "reception paper or label" less than 50,8 mm (2 inches) wide