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Information technology — Automatic identification and data capture techniques — JAB Code polychrome bar code symbology specification

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Foreword

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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

JAB Code is a colour-based, two-dimensional matrix symbology whose basic symbols are made up of colourful modules, arranged in either square or rectangle grids. JAB Code has two types of basic symbols: a primary symbol and the secondary symbol. A JAB Code contains one primary symbol, and optionally, multiple secondary symbols. A primary symbol contains four finder patterns, located at the corners of the symbol. Secondary symbols contain finder pattern.

A secondary symbol can be docked to a primary symbol, or another docked secondary symbol, in either a horizontal or vertical direction. JAB Code can encode from small to large amounts of data, correlated to user-specified percentages of the error correction.

Both manufacturers and users of bar code equipment require publicly available symbology standards when developing equipment and application standards. The publication of standardised symbology specifications, such as this one, are designed to achieve this.

Information technology — Automatic identification and data capture techniques — JAB Code polychrome bar code symbology specification

IMPORTANT — The electronic file of this document contains colours which are considered to be useful for the correct understanding of the document. Users should therefore consider printing this document using a colour printer.

1 Scope

This document defines the requirements for the symbology known as JAB Code. It specifies the JAB Code symbology characteristics, symbol structure, symbol dimensions, symbol cascading rules, data character encodation, error correction rules, user-selectable application parameters, print quality requirements and a reference decode algorithm.

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/IEC 646, *Information technology — ISO 7-bit coded character set for information interchange*

ISO/IEC 10646, *Information technology — Universal coded character set (UCS)*

ISO/IEC 15415, *Information technology — Automatic identification and data capture techniques — Bar code symbol print quality test specification — Two-dimensional symbols*

ISO/IEC 15424, *Information technology — Automatic identification and data capture techniques — Data Carrier Identifiers (including Symbology Identifiers)*

ISO/IEC 15434, *Information technology — Automatic identification and data capture techniques — Syntax for high-capacity ADC media*

3 Terms, definitions, abbreviated terms and symbols

For the purposes of this document, the following terms and definitions 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
module
single square in one colour within the matrix pattern that is the elemental entity used to encode data

3.1.2
finder pattern
fixed reference pattern at predefined positions in a matrix symbology, which enables the decode software to locate the JAB symbol in an image

3.1.3
alignment pattern
fixed reference pattern at predefined positions in a matrix symbology, which enables the decode software to resynchronize the coordinate mapping of the *modules* (3.1.1) in the event of moderate amounts of distortion of the image

3.1.4
data interleaving
procedure which pseudo-randomly arranges the data in a matrix symbology

3.1.5
colour palette
set of reference *modules* (3.1.1) of colours used in the symbol, which is located at predefined positions in a matrix symbology

3.1.6
padding bits
bits which do not represent data and are used to fill empty positions of the available encoding capacity after the final bit of encoded data

3.1.7
primary symbol
main symbol which contains finder patterns and is used to locate the whole JAB code

3.1.8
secondary symbol
appending symbols which may be used to encode more data with a lower overhead in terms of auxiliary *modules* (3.1.1)

3.1.9
host symbol
symbol, either primary or secondary, in a JAB Code which docks secondary symbols on its horizontal or vertical sides

3.1.10
JAB Code
colour two-dimensional matrix symbology

Note 1 to entry: JAB code is used for “just another bar code”.

3.2 Abbreviated terms

LDPC	low-density parity-check
SS	in primary symbol: symbol shape flag / in secondary symbol: same shape and size flag
MSK	masking reference
SE	same error correction level
V	side-version
E	error correction parameter
S	secondary positions
m	raw data bits
c	transmitted codeword

r received codeword

L number of iterations

FPDB fixed pattern damage in segment B

ECI extended channel interpretation

FNC1 function code one

GNU grid non-uniformity

UEC unused error correction

CSL centre surrounding layer

3.3 Mathematical symbols

For the purposes of this document, the following mathematical symbols apply:

N_c module colour mode indicating the number of module colours in the symbol

C symbol capacity in number of bits

P_n symbols net payload (the number of raw data bits)

P_g symbols gross payload (the number of encoded data bits)

P_e length of the encoded message including the metadata of docked secondary symbols and the flag bit

K number of error correction bits in the symbol, equal to P_g-P_n

H parity check matrix of LDPC code

w_r number of 1's in each row in H (the parity check matrix of LDPC code)

w_c number of 1's in each column in H (the parity check matrix of LDPC code)

3.4 Mathematical and logical operations

For the purposes of this document, the following mathematical and logic operations apply.

max(x,y) is the greater of x and y

div is the integer division operator

mod is the remainder after division

XOR is the exclusive-or logic function that outputs one only when the two inputs differ.

$\log_2(x)$ is the logarithm function to base 2.

ln(x) is the logarithm function to base e.

4 Symbol description

4.1 Basic characteristics

a) Encodable character set:

1) numeric data;

2) uppercase letters;

3) lowercase letters;

4) punctuation marks;

5) mixed characters;

6) alphanumeric data;

7) byte data (default interpretation: UTF-8 specified in ISO/IEC 10646);

8) ECI and FNC1.

b) Symbol type

1) In JAB Code there are two types of symbols: primary symbol and secondary symbol.

2) A JAB Code contains one primary symbol and optionally multiple secondary symbols.

c) Symbol shape

1) The primary symbol and secondary symbol in a JAB Code may be either square or rectangle.

2) Primary symbol and secondary symbol in a JAB Code may be of different shapes.

d) Symbol size

1) The smallest primary or secondary JAB Code symbol side size is 21 and the largest is 145. The smallest square symbol is 21 × 21 modules and the largest is 145 × 145 modules.

2) No quiet zone is required for the symbol.

e) Module colour

1) The number of module colours is configurable in two modes: 4 or 8 colours.

2) Guidelines for colour selection are given in Annex G.

f) Representation of data

1) A module represents $\log_2(N_c)$ binary bits. See 5.7.

2) The binary bits that a module represents correspond to the index value of the module colour in the colour palette.

g) Data capacity

1) The data capacity of JAB Code depends on the symbol size, the number of module colours, and the error correction level.

2) The capacity of a single-symbol square code is listed in Table 1.

h) Selectable error correction

1) User-selectable error correction levels are supported.

2) In one JAB Code, different error correction levels may be configured in each symbol.

i) Symbol cascading

1) Secondary symbols can be docked to the side of a primary symbol, or other secondary symbols.

2) JAB Code may have an arbitrary form by cascading primary and secondary symbols in horizontal and vertical directions while adhering to the order in Figure 14.

j) Code type: Matrix

k) Orientation independent: Yes

4.2 Summary of additional features

The use of the following additional features is optional in JAB Code:

a) Mirror Imaging: When JAB Code is obtained in mirror reversal, it is still possible to achieve a valid decode of a symbol with the standard reader. Refer to 6.2.

b) Extended Channel Interpretation: The ECI mechanism enables data using character sets other than the default encodable set (e.g., Arabic, Chinese, Cyrillic, Greek, Hebrew) and other data interpretations or industry-specific requirements to be represented.

4.3 Symbol structure

4.3.1 Square primary symbol

The structure of a square JAB Code primary symbol is shown in Figure 1 and given in Annex A. A square primary symbol shall consist of finder pattern, alignment pattern (starting with Side-Version 6, and larger), colour palette, encoded data and optionally metadata region. Four finder patterns are located at the four symbol corners respectively, with one module between the outermost layer and the border. No quiet zone surrounding the symbol is required. The primary symbol illustrated in Figure 1 is a square symbol of Side-Version 2, whose width and height are 25 modules.

4.3.2 Rectangle primary symbol

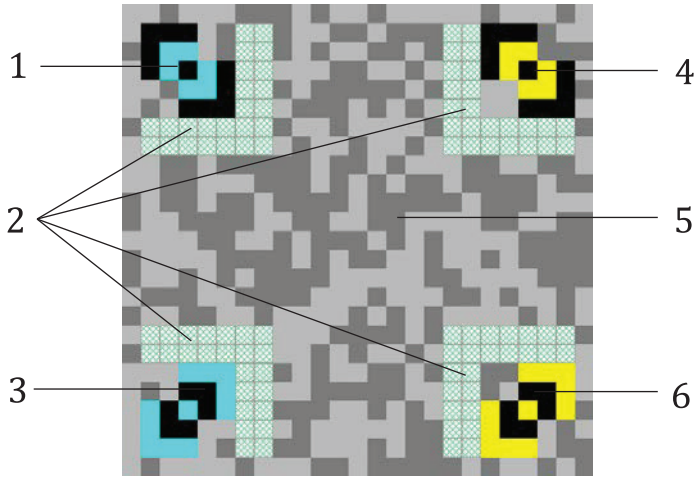
The structure of a rectangle JAB Code primary symbol is shown in Figure 2. The structure of a rectangle primary symbol is the same as a square primary symbol, except that the horizontal and vertical distance between the finder patterns are not equal. Like square symbols, no quiet zone is required for rectangle primary symbols. The primary symbol illustrated in Figure 2 is a rectangle symbol of a combination of Side-Version 5 and 2, of which the width is 37 modules and the height is 25 modules.

4.3.3 Square secondary symbol

The structure of a square JAB Code secondary symbol is shown in Figure 3. Except for finder patterns, secondary symbols contain the same patterns as the primary symbol, including alignment pattern, colour palette and encoded data region. In secondary symbols, the four finder patterns are replaced by four alignment patterns. Like the primary symbol, no surrounding quiet zone is required for secondary symbols. The secondary symbol illustrated in Figure 3 is a square symbol of Side-Version 2, whose width and height are 25 modules.

4.3.4 Rectangle secondary symbol

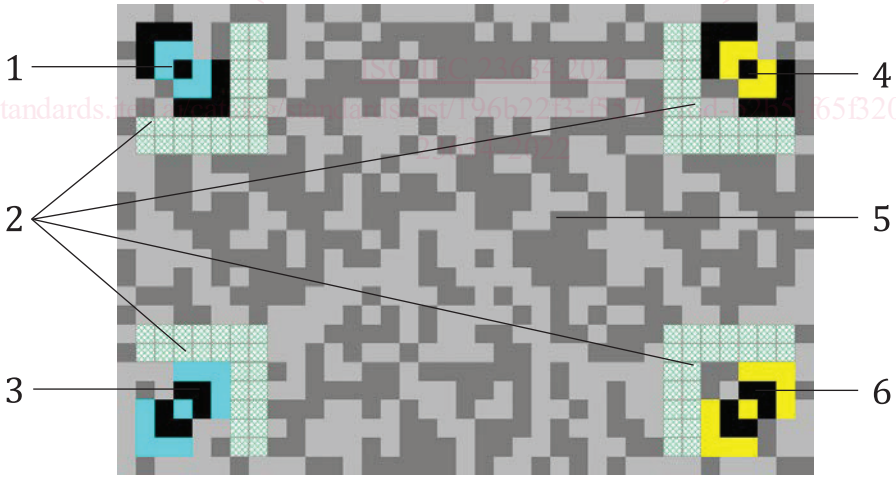
The structure of a rectangle JAB Code secondary symbol is shown in Figure 4. The structure of the rectangle secondary symbol is the same as the rectangle primary symbol, except that the finder patterns are replaced by four alignment patterns. No quiet zone is required for rectangle secondary symbols. The secondary symbol illustrated in Figure 4 is a rectangle symbol of a combination of Side-Version 5 and 2, whose width is 37 modules and whose height is 25 modules.



Key

1 Finder pattern UL
2 metadata and colour palette
3 Finder pattern LL
4 Finder pattern UR
5 encoded data
6 Finder pattern LR

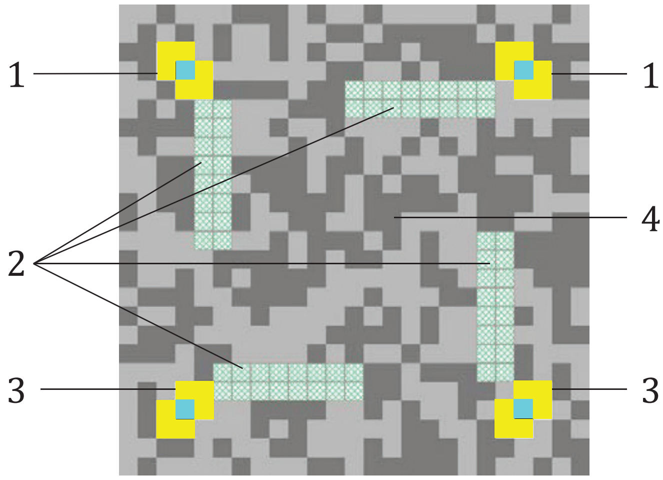
Figure 1 — Structure of square primary symbol



Key

1 Finder pattern UL
2 metadata and colour palette
3 Finder pattern LL
4 Finder pattern UR
5 encoded data
6 Finder pattern LR

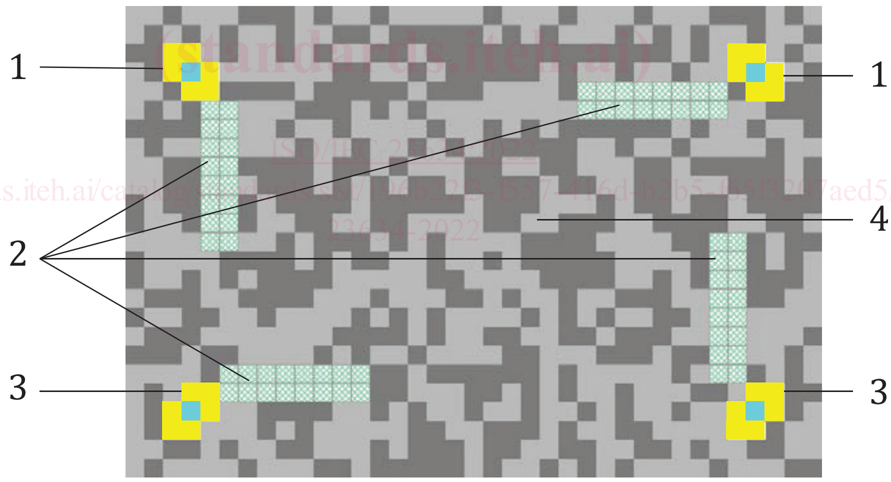
Figure 2 — Structure of rectangle primary symbol



Key

1 alignment pattern U
2 colour palette
3 alignment pattern L
4 encoded data

Figure 3 — Structure of square secondary symbol



Key

1 alignment pattern U
2 colour palette
3 alignment pattern L
4 encoded data

Figure 4 — Structure of rectangle secondary symbol

4.3.5 Symbol side size

The side of a JAB Code symbol may have one of 32 different sizes, referred to as Side-Version 1, Side-Version 2, ... Side-Version 32. See Table 1. The side size increases in steps of 4 modules, from 21 modules in Side-Version 1, to 145 modules in Side-Version 32. A square symbol has the same Side-Version for both the horizontal and vertical sides, while a rectangle symbol may have any combination of two different side-versions for the horizontal and vertical sides. The smallest square symbol measures 21 × 21 modules and the largest square symbol measures 145 × 145 modules. The smallest rectangle

symbol measures 21 × 25 modules and the largest rectangle symbol measures 141 × 145 modules. The rectangle symbol of 21 × 145 or 145 × 21 modules has the maximal proportion between the horizontal and vertical sides.

The capacities listed in Table 1 are based on the recommended error correction level 3 for square symbols, and a default of 8 colours. The number of data modules can be calculated according to the following formulae:

Distance of Finder pattern Centre to Border: $DFCB = 4$

Minimum Distance between Alignment patterns: $MDBA = 16$

Number of alignment pattern modules:

$$a_x = max(0, \lfloor (SideSize_x - DFCB \times 2 + 1) / MDBA - 1 \rfloor)$$

$$a_y = max(0, \lfloor (SideSize_y - DFCB \times 2 + 1) / MDBA - 1 \rfloor)$$

$$a = ((a_x + 2) \times (a_y + 2) - 4) \times 7$$

Number of colours used in JAB code:

$$NumberOfModuleColor = \begin{cases} 4, if\ 4\ color\ selected \\ 8, if\ 8\ color\ selected \end{cases}$$

Number of colour palette modules: $C_{Palette} = (NumberOfModuleColor - 2) \times 4$

Number of finder pattern modules: $F_{Primary} = 4 \times 17; F_{Secondary} = 4 \times 7$

Number of Metadata modules:

$$Metadata = \frac{MetadataLength}{\log_2(NumberOfModuleColor)} * log_2(2)$$

Number of data modules in primary: $SideSize_x \times SideSize_y - a - C_{Palette} - F_{Primary} - Metadata$

Number of data modules in secondary: $SideSize_x \times SideSize_y - a - C_{Palette} - F_{Secondary}$

Table 1 — Symbol side versions and square symbol capacity of JAB Code (default metadata)

Side-Version	Side size (in modules)	Number of data modules				Symbol net payload P_n (in bits)			
		Square Primary		Square Secondary		Square Primary		Square Secondary	
		4	8	4	8	4	8	4	8
1	21	338	349	405	389	676	1 047	810	1 167
2	25	522	533	589	573	1 044	1 599	1 178	1 719
3	29	738	749	805	789	1 476	2 247	1 610	2 367
4	33	986	997	1 053	1 037	1 972	2 991	2 106	3 111
5	37	1 266	1 277	1 333	1 317	2 532	3 831	2 666	3 951
6	41	1 543	1 554	1 610	1 594	3 086	4 662	3 220	4 782
7	45	1 887	1 898	1 954	1 938	3 774	5 694	3 908	5 814
8	49	2 263	2 274	2 330	2 314	4 526	6 822	4 660	6 942
9	53	2 671	2 682	2 738	2 722	5 342	8 046	5 476	8 166
10	57	3 062	3 073	3 129	3 113	6 124	9 219	6 258	9 339
11	61	3 534	3 545	3 601	3 585	7 068	10 635	7 202	10 755
12	65	4 038	4 049	4 105	4 089	8 076	12 147	8 210	12 267
13	69	4 574	4 585	4 641	4 625	9 148	13 755	9 282	13 875
14	73	5 079	5 090	5 146	5 130	10 158	15 270	10 292	15 390
15	77	5 679	5 690	5 746	5 730	11 358	17 070	11 492	17 190
16	81	6 311	6 322	6 378	6 362	12 622	18 966	12 756	19 086
17	85	6 975	6 986	7 042	7 026	13 950	20 958	14 084	21 078

Table 1 *(continued)*

Side-Version	Side size (in modules)	Number of data modules				Symbol net payload P_n (in bits)			
		Square Primary		Square Secondary		Square Primary		Square Secondary	
		4 8		4 8		4 8		4 8	
18	89	7 594	7 605	7 661	7 645	15 188	22 815	15 322	22 935
19	93	8 322	8 333	8 389	8 373	16 644	24 999	16 778	25 119
20	97	9 082	9 093	9 149	9 133	18 164	27 279	18 298	27 399
21	101	9 874	9 885	9 941	9 925	19 748	29 655	19 882	29 775
22	105	10 607	10 618	10 674	10 658	21 214	31 854	21 348	31 974
23	109	11 463	11 474	11 530	11 514	22 926	34 422	23 060	34 542
24	113	12 351	12 362	12 418	12 402	24 702	37 086	24 836	37 206
25	117	13 271	13 282	13 338	13 322	26 542	39 846	26 676	39 966
26	121	14 118	14 129	14 185	14 169	28 236	42 387	28 370	42 507
27	125	15 102	15 113	15 169	15 153	30 204	45 339	30 338	45 459
28	129	16 118	16 129	16 185	16 169	32 236	48 387	32 370	48 507
29	133	17 166	17 177	17 233	17 217	34 332	51 531	34 466	51 651
30	137	18 127	18 138	18 194	18 178	36 254	54 414	36 388	54 534
31	141	19 239	19 250	19 306	19 290	38 478	57 750	38 612	57 870
32	145	20 383	20 394	20 450	20 434	40 766	61 182	40 900	61 302

4.3.6 Module dimension

JAB Code symbols (both primary and secondary symbols) shall conform to the following dimensions:

X dimension: the width of a module shall be specified by the application, taking into account the technologies used to produce and scan the symbol.

Y dimension: the height of a module shall be equal to the X dimension.

No limit is placed on the module size in this specification. However, all modules in the symbols of a JAB Code shall be of the same size.

4.3.7 Finder pattern

There are four types of finder patterns in JAB Code, i.e., Finder Pattern UL, Finder Pattern UR, Finder Pattern LR and Finder Pattern LL, located at the upper left, the upper right, the lower right and lower left corners respectively as illustrated in Figure 6. Each finder pattern contains two equal square references made up of 3 × 3 modules as illustrated in Figure 5 for the UL finder pattern, connected with each other by an overlapping module (core module).

The finder patterns have different orientations. The core module of Finder Pattern UL and Finder Pattern UR shall be the lower right module of the upper reference, and the upper left module of the lower reference, respectively. In Finder Pattern LR and Finder Pattern LL, the core shall be the lower left module of the upper reference and the upper right module of the lower reference.

Each square reference in a finder pattern is constructed of three layers; all the same width of one module. The layers in the two references are symmetric with respect to the core module, as illustrated in Figure 5. Each finder pattern contains two colours. The colour of each layer is different from its adjacent layers. Finder Pattern UL and Finder Pattern LL consist of black and cyan layers. Finder Pattern UR and Finder Pattern LR are made up of yellow and black layers. Finder Pattern UL and UR have a black core. Finder Pattern LR has a yellow core and Finder Pattern LL has a cyan core.