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Information technology — Automatic identification and data capture techniques — Bar code symbology specifications — PDF417

Technologies de l'information — Techniques automatiques d'identification et de capture des données — Spécifications pour les symboles de codes à barres — PDF417

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

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

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.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights.

ISO/IEC 15438 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 31, *Automatic identification and data capture techniques*.

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Annexes A to N form a normative part of this International Standard. Annexes P to U are for information only.

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Introduction

The technology of bar coding is based on the recognition of patterns of bars and spaces of defined dimensions. There are various methods of encoding information in bar code form, known as symbologies, and the rules defining the translation of characters into bar and space patterns and other essential features are known as the symbology specification.

Manufacturers of bar code equipment and users of bar code technology require publicly available standard symbology specifications to which they can refer when developing equipment and application standards. It is the intent and understanding of ISO/IEC that the symbology presented in this standard is entirely in the public domain and free of all user restrictions, licences and fees.

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Information technology — Automatic identification and data capture techniques — Bar code symbology specifications — PDF417

1 Scope

This International Standard specifies the requirements for the bar code symbology known as PDF417. It specifies PDF417 symbology characteristics, data character encodation, symbol formats, dimensions, error correction rules, decoding algorithm, and a number of application parameters.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

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ISO/IEC 646:1991, *Information technology — ISO 7-bit coded character set for information exchange*

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ISO/IEC 8859-1:1998, *Information technology — 8-bit single-byte coded graphic character sets — Part 1: Latin alphabet No. 1*

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

AIM International Technical Specification: *Extended Channel Interpretations — Part 1: Identification Schemes and Protocol*

AIM International Technical Specification: *Extended Channel Interpretations — Part 2: Registration of Coded Character Sets and Other Data Formats*

EN 796, *Bar coding — Symbology identifiers*

EN 1556, *Bar coding — Terminology*

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3 Definitions, mathematical symbols and abbreviations

3.1 Terms and definitions

For the purposes of this International Standard, the following terms and definitions given in EN 1556 apply.

algorithm, application standard, ASCII, autodiscrimination, bar, bar code, bi-directional, binary, bit, codeword, column, continuous code, data character, data codeword, data compaction, data region, decode algorithm, decoder, element, encode, error correction level, human readable character, leading zeros, linear symbology, module, modulo, multi-row symbology, n, k symbology, numeric, overhead, pad character, pad codeword, quiet zone, reference decode algorithm, row, scanner, self-checking, space, start character, stop character, symbol aspect ratio, symbol character, symbology, symbology identifier, symbol width, X-dimension, Y-dimension

The following definitions also apply to this International Standard.

3.1.1 Basic Channel Model:

A standard system for encoding and transmitting bar code data where data message bytes are output from the decoder but no control information about the message is transmitted. A decoder, complying to this model, operates in Basic Channel Mode.

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3.1.2 Bar-space sequence:

The sequence which represents the module widths of the elements of a symbol character.

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3.1.3 Cluster:

One of three subsets of PDF417 symbol characters, all of which are mutually exclusive. The symbol characters in a given cluster conform with particular structural rules which are used in decoding the symbology.

3.1.4 Compaction mode:

The name given to one of three data compaction algorithms in PDF417: Text, Numeric and Byte Compaction modes. These modes efficiently map 8-bit data bytes into PDF417 codewords.

3.1.5 Error correction codeword:

A codeword in a symbol which encodes a value derived from the error correction codeword algorithm to enable decode errors to be detected and, depending on the error correction level, to be corrected.

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3.1.6 Extended Channel Interpretation:

A procedure within some symbologies, including PDF417, to replace the default interpretation with another interpretation in a reliable manner. The interpretation intended prior to producing the symbol can be retrieved after decoding the scanned symbol to recreate the data message in its original format.

3.1.7 Extended Channel Model:

A system for encoding and transmitting both data message bytes and control information about the message. A decoder, complying to this model, operates in Extended Channel Mode. The control information is communicated using Extended Channel Interpretation (ECI) escape sequences.

3.1.8 Function codeword:

A codeword in a symbology which initiates a particular operation within the symbology, for example to switch between data encoding sets, to invoke a compaction scheme, to program the reader, to invoke Extended Channel Interpretations.

3.1.9 Global Label Identifier:

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A procedure in the PDF417 symbology, which behaves in a similar manner to Extended Channel Interpretation. The GLI system was the symbology-dependent precursor to the symbology-independent ECI system.

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3.1.10 Macro PDF417:

A procedure within the PDF417 symbology to logically distribute data from a computer file across a number of related PDF417 symbols. The procedure considerably extends the data capacity beyond that of a single symbol. This procedure is similar to the Structured Append feature in other symbologies.

3.1.11 Mode Latch codeword:

A codeword which is used to switch from one mode to another mode, which stays in effect until another latch or shift codeword is implicitly or explicitly brought into use, or until the end of the label is reached.

3.1.12 Mode Shift codeword:

A codeword which is used to switch from one mode to another for one codeword, after which encoding returns to the original mode.

3.1.13 Row Indicator codeword:

A PDF417 codeword adjacent to the start or stop character in a row, which encodes information about the structure of the PDF417 symbol in terms of the row identification, total number of rows and columns, and the error correction level.

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3.1.14 Symbol Length Descriptor:

The codeword in a PDF417 symbol which encodes the total number of data codewords in the symbol. The Symbol Length Descriptor shall always be the first codeword in a PDF417 symbol.

3.2 Mathematical symbols and operations

For the purposes of this standard the mathematical symbols which follow shall apply. There are some cases where the symbols below have been used in a different manner in an equation. This has been done for consistency with a more general use of the notation and is always clearly defined in the text.

A symbol aspect ratio (height to width) of a PDF417 symbol

b the element width in a symbol character

c number of columns in the symbol in the data region (excluding start, stop and row indicator codewords)

d data codeword including all function codewords

E error correction codeword

e an edge to similar edge dimension in a symbol character

F row number

f number of substitution errors

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H height of symbol including quiet zone

K cluster number

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k number of error correction codewords

L left row indicator

l number of erasures

m number of source data codewords prior to the addition of the Symbol Length Descriptor and any pad codewords

n total number of data codewords including Symbol Length Descriptor and any pad codewords

p the pitch or width of a symbol character

Q_H horizontal quiet zone

Q_V vertical quiet zone

R right row indicator

r number of rows in the symbol

s error correction level

W width of symbol including quiet zone

X X-dimension or module width

Y module height (also called row height)

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For the purposes of this standard the mathematical operations which follow shall apply:

div is the integer division operator, rounding down

INT is the integer value i.e. where a number is rounded down to its whole number component, ignoring its decimal fractions

mod is the positive integer remainder after division. If the remainder is negative, add the value of the divisor to make it positive. For example, the remainder of -29 160 divided by 929 is -361 which when added to 929 yields 568.

3.3 Abbreviations

For the purposes of this standard, the following abbreviations shall apply:

ECI Extended Channel Interpretation

GLI Global Label Identifier

4 Requirements

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4.1 Symbology characteristics

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4.1.1 Basic characteristics

PDF417 is a bar code symbology with the following basic characteristics:

a. Encodable character set:

   1. Text Compaction mode (see 4.4.2) permits all printable ASCII characters to be encoded, i.e. values 32 - 126 inclusive in accordance with ISO/IEC 646, as well as selected control characters.
   2. Byte Compaction mode (see 4.4.3) permits all 256 possible 8-bit byte values to be encoded. This includes all ASCII characters value 0 to 127 inclusive and provides for international character set support.
   3. Numeric Compaction mode (see 4.4.4) permits efficient encoding of numeric data strings.
   4. Up to 811 800 different character sets or data interpretations.
   5. Various function codewords for control purposes.

b. Symbol character structure: (n, k, m) characters of 17 modules (n), 4 bar and 4 space elements (k), with the largest element 6 modules wide (m).

c. Maximum possible number of data characters per symbol (at error correction level 0): 925 data codewords which can encode:

   1. Text Compaction mode: 1 850 characters (at 2 data characters per codeword).
   2. Byte Compaction mode: 1 108 characters (at 1,2 data characters per codeword).
   3. Numeric Compaction mode: 2 710 characters (at 2,93 data characters per codeword)

   At the minimum recommended error correction level, there are 863 data codewords which can encode:

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1. Text Compaction mode: 1 726 characters (at 2 data characters per codeword).
2. Byte Compaction mode: 1 033 characters (at 1,2 data characters per codeword).
3. Numeric Compaction mode: 2 528 characters (at 2,93 data characters per codeword)

d. Symbol size:

1. Number of rows: 3 to 90.
2. Number of columns: 1 to 30.
3. Width in modules: 90X to 583X including quiet zones.
4. Maximum codeword capacity: 928 codewords.
5. Maximum data codeword capacity: 925 codewords.

Since the number of rows and the number of columns are selectable, the aspect ratio of a PDF417 symbol may be varied when printing to suit the spatial requirements of the application.

e. Selectable error correction: 2 to 512 codewords per symbol (see 4.7).

f. Non-data overhead:

1. Per row: 73 modules, including quiet zones.
2. Per symbol: a minimum of 3 additional codewords, represented as symbol characters.

g. Code type: continuous, multi-row two-dimensional.

h. Character self-checking: Yes.

i. Bi-directionally decodable: Yes.

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4.1.2 Summary of additional features

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The following summary is of additional features which are inherent or optional in PDF417:

a. **Data compaction**: (inherent) Three schemes are defined to compact a number of data characters into codewords. Generally data is not directly represented on a one character for one codeword basis (see 4.4.2 to 4.4.4).

b. **Extended Channel Interpretations**: (optional) These mechanisms allow up to 811 800 different data character sets or interpretations to be encoded (see 4.5).

c. **Macro PDF417**: (optional) This mechanism allows files of data to be represented logically and consecutively in a number of PDF417 symbols. Up to 99 999 different PDF417 symbols can be so linked or concatenated and be scanned in any sequence to enable the original data file to be correctly reconstructed (see 4.13).

d. **Edge to edge decodable**: (inherent) PDF417 can be decoded by measuring elements from edge to similar edge (see 4.3.1).

e. **Cross row scanning**: (inherent) The combination of the following three characteristics in PDF417 facilitates cross row scanning:

- being synchronised horizontally, or self clocking
- row identification
- being vertically synchronised, by using the cluster values to achieve local row discrimination.

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This combination allows a single linear scan to cross a number of rows and achieve a partial decode of the data so long as at least one complete symbol character per row is decoded into its codeword. The decoding algorithm can then place the individual codewords into a meaningful matrix.

f. **Error correction**: (inherent) A user may define one of 9 error correction levels. All but Level 0 not only detect errors but can correct erroneously decoded or missing codewords (see 4.7).

g. **Compact PDF417**: (optional) In relatively 'clean' environments, it is possible to reduce some of the row overhead to improve the symbol density (see 4.12).

NOTE: In earlier specifications of PDF417, this was called Truncated PDF417. Compact PDF417 is the preferred term to avoid confusion with the more general use of the term 'truncated'.

4.2 Symbol structure

4.2.1 PDF417 symbol parameters

Each PDF417 symbol consists of a stack of vertically aligned rows with a minimum of 3 rows (maximum 90 rows). Each row shall include a minimum of 1 symbol character (maximum 30 symbol characters), excluding start, stop and row indicator columns. The symbol shall include a quiet zone on all four sides. Figure 1 illustrates a PDF417 symbol encoding the text: PDF417 Symbology Standard.

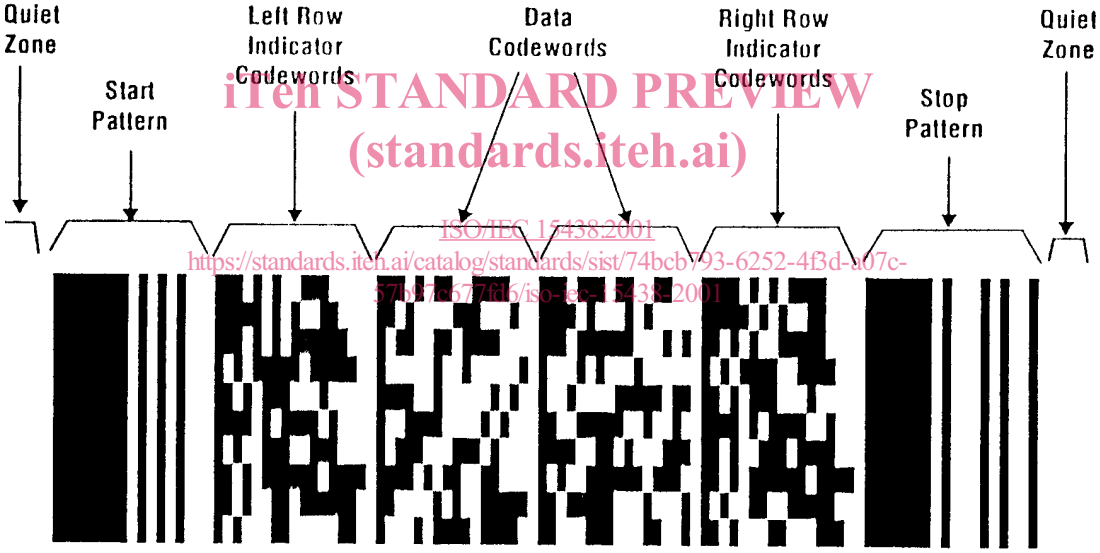

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Figure 1 — PDF417 Symbol Structure

4.2.2 Row parameters

Each PDF417 row shall comprise:

a. leading quiet zone
b. start character
c. left row indicator symbol character
d. 1 to 30 symbol characters
e. right row indicator symbol character
f. stop character
g. trailing quiet zone

NOTE: The number of symbol characters (or codewords) defined in item 'd' above is equal to the number of data columns in the PDF417 symbol.

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