
**Information technology — Automatic
identification and data capture
techniques — Bar code symbology
specifications — Interleaved 2 of 5**

*Technologies de l'information — Techniques automatiques d'identification
et de capture des données — Spécifications des symbologies des codes à
barres — Code 2 parmi 5 entrelacé*

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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.

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

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

International Standard ISO/IEC 16390 was prepared by BSI and was adopted, under a special “fast-track procedure”, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in parallel with its approval by national bodies of ISO and IEC.

Annexes A to D of this International Standard are for information only.

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Introduction

The technology of bar coding is based on the recognition of patterns encoded in bars and spaces of defined dimensions. There is a number of 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. Interleaved 2 of 5 is one such symbology.

Previously, symbology specifications have been developed and published by a number of organizations, resulting in certain instances in conflicting requirements for certain symbologies.

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.

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Information technology — Automatic identification and data capture techniques — Bar code symbology specifications — Interleaved 2 of 5

1 Scope

This International Standard specifies the requirements for the bar code symbology known as Interleaved 2 of 5; it specifies Interleaved 2 of 5 symbology characteristics, data character encodation, dimensions, tolerances, decoding algorithms and application-defined 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.

ISO 646:1983, *Information technology — ISO 7-bit coded character set for information interchange*.

ISO 7064:1983, *Data processing — Check character systems*.

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

ISO/IEC 15424, *Automatic identification and data capture techniques — Data carrier/symbology identifiers*.

EN 1556:1997, *Bar Coding — Terminology*.

3 Definitions

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

4 Requirements

4.1 Symbology characteristics

The characteristics of Interleaved 2 of 5 are:

- 1) Encodable character set: numeric 0 to 9 (ASCII characters 48 - 57 inclusive, in accordance with ISO 646);
- 2) Code type: continuous;
- 3) Elements per symbol character: 5, of which 2 wide and 3 narrow, encoded as either five bars or five spaces;
- 4) Character self-checking: yes;
- 5) Data string length encodable: variable (even number of digits);

- 6) Bidirectionally decodable: yes;
- 7) Symbol check character: one, optional (see annex A);
- 8) Symbol character density: 14 to 18 modules per symbol character pair, depending on wide/narrow ratio;
- 9) Non-data overhead: 8 to 9 modules, depending on wide/narrow ratio.

4.2 Symbol structure

Interleaved 2 of 5 symbols shall comprise:

- 1) leading quiet zone;
- 2) start pattern;
- 3) one or more pairs of symbol characters representing data (inclusive of optional symbol check character);
- 4) stop pattern;
- 5) trailing quiet zone.

4.3 Character encodation

4.3.1 Data character encodation

Table 1 defines the Interleaved 2 of 5 character encodation. In the column headed "Binary representation" the character 1 is used to represent a wide element and 0 a narrow element.

Table 1 — Binary representation of character encodation

Data character	Binary representation				
0	0	0	1	1	0
1	1	0	0	0	1
2	0	1	0	0	1
3	1	1	0	0	0
4	0	0	1	0	1
5	1	0	1	0	0
6	0	1	1	0	0
7	0	0	0	1	1
8	1	0	0	1	0
9	0	1	0	1	0

Table 1 uses a modified binary coded decimal encoding scheme. The four left-most bit positions for each character are assigned weights of 1, 2, 4 and 7, from left to right; the fifth position is used for an even parity bit. The sum of the positional weights of the '1' bits is equivalent to the data character value, except in the case of the data

character 0, where the weights 4 and 7 are applied. The parity bit ensures that there are always two '1' bits per character.

The following algorithm defines the rules to convert numeric data into the symbol characters of an Interleaved 2 of 5 symbol:

Step in Algorithm	Example
1) Calculate check character if required by the application standard. See 4.6;	
2) If the data string, including check characters, has an odd number of digits, add a leading zero;	367 0367
3) Subdivide the numeric string into digit pairs;	0367 03 and 67
4) Encode the digit pairs as follows:	
a) Encode the leading digit of each pair into bar patterns as shown in Table 1;	0 and 6
b) Encode the second digit of each pair into space patterns as shown in Table 1;	3 and 7
5) Form each symbol character pair by taking the bar and space elements alternately from the patterns derived from steps 4 a) and 4 b), commencing with the first bar of the pattern for the first digit, followed by the first space of the pattern for the second digit.	

Figure 1 illustrates the sequence of bar and space elements corresponding to the data character pairs "03 67".

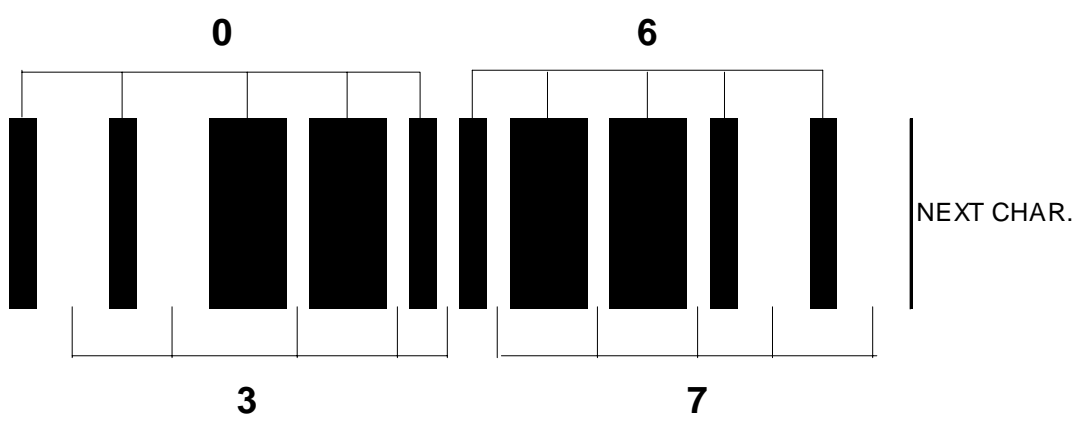


Figure 1 — Interleaved 2 of 5 character pairs, encoding "03 67"

4.3.2 Start and stop patterns

The start pattern shall consist of four narrow elements in the sequence bar - space - bar - space. The stop pattern shall consist of a wide bar - narrow space - narrow bar sequence.

The start pattern shall be positioned at the normal left end of the data symbol characters adjacent to the first bar of the most significant digit. The stop pattern shall be positioned at the normal right end of the data symbol characters adjacent to the final space of the least significant digit.

There is no assigned human readable interpretation of the start and stop patterns and they shall not be transmitted by the decoder.

Figure 2 illustrates the start and stop patterns and their relationship to the symbol data characters.

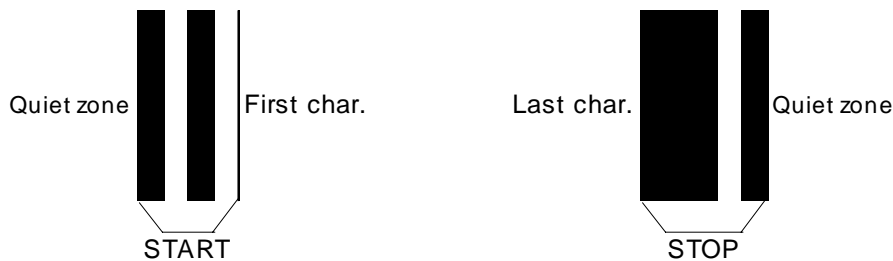


Figure 2 — Start and stop patterns

Figure 3 illustrates a complete bar code symbol for the number 1234 showing the necessary quiet zones.

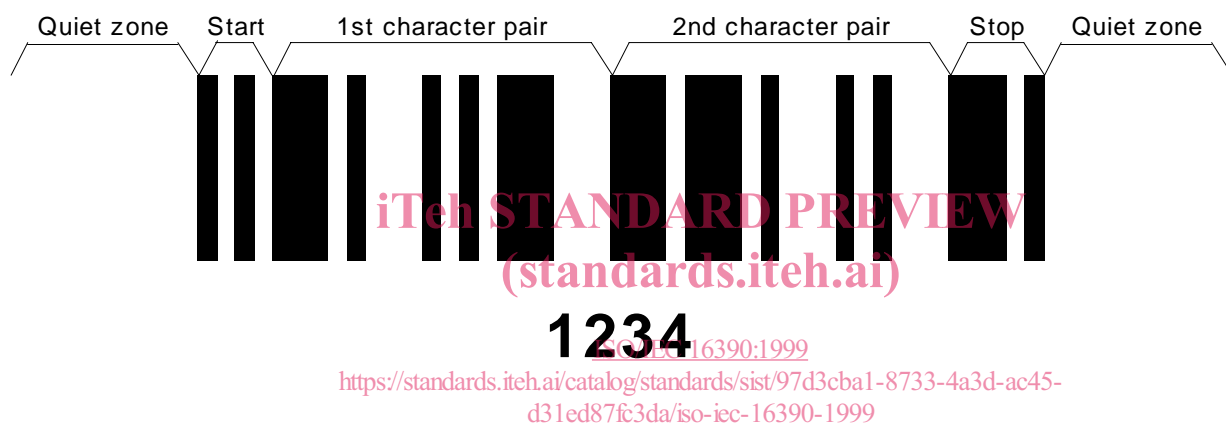


Figure 3 — Interleaved 2 of 5 symbol inclusive of quiet zones

4.3.3 Optional symbol check character

Annex A defines the check character position and calculation.

4.4 Dimensions

Interleaved 2 of 5 symbols shall use the following nominal dimensions:

- width of narrow element (X): the X dimension of Interleaved 2 of 5 symbols may be defined by the application specification in accordance with the needs of the application in question. See 4.6.1;
- wide/narrow ratio (N): 2,0:1 to 3,0:1;
- minimum width of quiet zone: $10X$;
- recommended minimum bar code height for manual scanning: 5,0 mm or 15 % of symbol width excluding quiet zones, whichever is greater.

The width, W (in millimetres) of an Interleaved 2 of 5 symbol, including quiet zones, can be calculated from the following expression:

$$W=(P(4N+6)+N+6)X+2Q$$

where:

P is the number of character pairs;

N is the wide/narrow ratio;

X is the width of a narrow element in millimetres;

Q is the width of the quiet zone in millimetres.

4.5 Reference decode algorithm

Bar code reading systems are designed to read imperfect symbols to the extent that practical algorithms permit. This section describes the reference decode algorithm used in the computation of the decodability value described in ISO/IEC 15416.

- 1) Confirm presence of a leading quiet zone.
- 2) Confirm presence of a valid start pattern by checking that the initial four elements are each less than $7/64$ the sum of the next ten elements (if this fails, reverse decoding may be attempted).
- 3) Decode the exact number of character pairs specified by the application as follows:
 - (1) Record the widths of the ten elements of a character pair and accumulate their sum, S ;
 - (2) Compute a threshold, $T = (7/64)S$;
 - (3) Compare the individual widths with the threshold: if element width is greater than T , assume element is wide; if not, assume it is narrow;
- 4) Confirm the valid decoding of the character pairs;
- 5) After decoding the proper number of character pairs, confirm the presence of a valid stop pattern by checking that the next element width is greater than or equal to the T of the previous symbol character and that the following two elements widths are less than T ;
- 6) Confirm the presence of a trailing quiet zone.

4.6 Application-defined parameters

Application standards shall define parameters of Interleaved 2 of 5 symbols specified in this International Standard as variable, as follows:

4.6.1 Symbology and dimensional characteristics

In order for an Interleaved 2 of 5 symbol to be printed and to be scannable in a given application it is necessary for the following symbology and dimensional parameters to be specified:

- 1) The number of data characters in the symbol, which may be fixed, variable or variable up to a defined maximum (see A.1);
- 2) Whether the weighted modulo 10 complement symbol check character is to be used (see A.2) and whether it is to be transmitted by the decoder;
- 3) Whether a data check character is to be used and if so the algorithm for its calculation;
- 4) Range of X dimension;
- 5) Range of nominal wide/narrow ratio;
- 6) Minimum bar height.