BRITISH STANDARD

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AIDC technologies — Operational aspects affecting the reading of bar code symbols

The European Standard EN 1649:2004 has the status of a British Standard

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BSI
British Standards

National foreword

This British Standard is the official English language version of EN 1649:2004. It supersedes DD ENV 1649:1996, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee IST/34, Automatic identification and data capture techniques, which has the responsibility to:

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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AIDC technologies - Operational aspects affecting the reading of bar code symbols

Techniques d'identification automatique et de saisie des données - Aspects de mise en oeuvre affectant la lecture des symboles en codes à barres

AutoID-Technologien - Einflussgrößen auf die Lesung von Strichcodes

This European Standard was approved by CEN on 14 July 2004.

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Contents

Foreword

This document (EN 1649:2004) has been prepared by Technical Committee CEN/TC 225, "Bar coding", the secretariat of which is held by NEN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by February 2005, and conflicting national standards shall be withdrawn at the latest by February 2005.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard : Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

This document supersedes ENV 1649:1995

Introduction

Implementation of the technology of bar coding requires the originators of the bar code marking, and those wishing to make use of the bar codes to capture data relating to the marked entity automatically, to work to a common application standard. The application standard may make reference to publicly available specifications for the underlying technical aspects of the bar code symbol and of the equipment for its production and reading.

By means of such publicly available standards, the producers of symbols and those wishing to read the symbols can be aware of the requirements which must be met by any symbol production and symbol reading equipment which they specify for their respective systems.

This document also provides the manufacturers of both bar code marking and bar code reading equipment with the requirements to which that equipment must comply, for that application.

This document provides the means by which bodies which are making application standards for industries can ensure that all relevant technical requirements are addressed during the standards making process.

1 Scope

This document specifies the operational aspects affecting the reading of bar code symbols which must be considered in the preparation of application standards. It defines the subjects which must be addressed by application standards if they are to provide practical guidance to the user industries for whose use they are developed.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 1556:1998, *Bar Coding — Terminology.*

EN 1573, *Bar Coding — Multi-industry transport label.*

EN 12323, *Bar coding — Symbology specification — "Code 16k".*

EN ISO/IEC 15416, *Information technology - Automatic identification and data capture techniques - Bar code print quality test specification - Linear symbols (ISO/IEC 15416:2000).*

EN ISO/IEC15438 *Information technology - Automatic identification and data capture techniques - Bar code symbology specifications - PDF417 (ISO/IEC 15438:2001).*

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

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

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

ISO/IEC 15418 *Information technology -- EAN/UCC Application Identifiers and Fact Data Identifiers and Maintenance*.

ISO/IEC 15420 *Information technology — Automatic identification and data capture techniques — Bar code symbology specification — EAN/UPC.*

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

ISO/IEC 16022, Information technology -- International symbology specification -- Data matrix.

ISO/IEC 16023, *Information technology -- International symbology specification – MaxiCode.*

ISO/IEC 16390 *Information technology — Automatic identification and data capture techniques — Bar code symbology specifications — Interleaved 2 of 5.*

ISO/IEC 18004 *Information technology-Automatic identification and data capture techniques — Barcode symbology — QR Code.*

General EAN▪UCC Specifications (EAN International, Brussels, 2004).

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 1556:1998 and the following apply.

3.1
closed system
application which is intended for use by a closed group of users, typically within a single organisation or subject to a specific agreement.

NOTE Existing closed systems are used subject to bilateral agreement between the participants.

3.2
open system
application in which independent parties may freely participate and in which bilateral agreements are not necessary

3.3
application standard
specification defining the method by which and conditions under which automatic identification and data capture technology may be applied to a particular purpose, prescribing, for example, data formats, optical requirements and symbology related parameters as subsets of the total range defined by relevant technical standards

4 Requirements

4.1 Closed or open system

The developer of a standard shall determine if the system to which the application standard applies is a closed or an open system.

4.2 Pre-existing standards

Before commencing the making of a new application standard, careful consideration should be given to the potential of adopting an existing standard. Many currently used application standards are readily adaptable to specific industry uses whilst remaining totally compatible with their existing uses. Broadening the scope of existing international, multi industry standards, provides for the ready trading of bar code marked items internationally and between industry sectors and is, therefore, the preferred option. It should be noted that the proliferation of standards is a waste of resources and is contrary to the principles of standardisation.

4.3 Data to be encoded

4.3.1 Type of Data to be Encoded

The choice of symbology will be influenced by the type of data to be encoded; which can be:

— numeric

— alphanumeric

— ASCII

other character sets which, particularly in high capacity two dimensional symbologies, may be accessed by the use of the AIM : ECI — Part 1. Annex A includes details of those symbologies which support this standard.

The character set required to encode the data content shall be a subset of the encodable character set of the symbology. There are symbologies covered by European and International Standards, the encodable character set of which meet all these requirements. For a given application, the character set used may be a limited part of the total character set available.

NOTE The character sets encodable by symbologies covered by European or International Standards are described in annex A.

4.3.2 Data string length

4.3.2.1 Linear symbols

The data string length to be encoded will influence the length of linear bar code symbols. The specification of long data strings, and the resultant long symbols, may be the cause of symbols being difficult to scan with a high degree of reliability and ease. It will also limit the choice of bar code printing and reading systems which may be used for a particular application. In particular some types of bar code readers may have limitations in the data string length which may be decoded and transmitted to the host system.

4.3.2.2 Two dimensional symbols

For some applications the data string length to be encoded may exceed that which can be encoded in a linear symbol. In such cases high capacity two dimensional multi-row bar code or matrix symbols can be used. In their largest sizes these may permit up to two thousand characters of data to be encode in a symbol. Some two dimensional symbologies permit the decoded data from more than one symbol to be concatenated into a single data string, thus enabling very large amounts of data to be encoded in a set of symbols.

4.3.3 Data check characters

For applications where key entry is used, or where data security is critical, data check characters as distinct from symbol check characters should be used. The system of data check characters used will depend upon the application, a suitable algorithm may be selected from those described in ISO/IEC 7064.

4.4 Symbology selection

4.4.1 General

When selecting a symbology or symbologies for any particular application every aspect of the application should be considered. The symbology which is specified for use in an application standard, should be one of those symbologies covered by European or International Standards.

NOTE Annex B compares the features of two dimensional symbologies standardised by CEN and ISO/IEC.

4.4.1.1 Linear symbols

The following exceptional factors shall be taken into consideration during the selection of a symbology for an application.

a) "**EAN/UPC" Symbology (ISO/IEC 15420)**

This symbology shall be used only in accordance with the EAN▪UCC General Specifications.

b) "**Interleaved 2 of 5" Symbology (ISO/IEC 16390)**

In Interleaved 2 of 5 symbols, the bar patterns of the start and stop patterns may be found as the respective end and beginning of certain encoded symbol characters within the symbol. There is therefore no guarantee that a partial scan of the symbol will not produce a valid read for an embedded symbol having fewer characters. Two additional measures should be applied to minimise the risk of such partial reads, fixing the symbol length and applying bearer bars:

1) Fixed length symbols

In any application standard the number of characters encoded in an Interleaved 2 of 5 symbol should be fixed, and reading or data processing equipment for that application should be programmed to accept only messages of that defined length.

2) Bearer bars

The purpose of bearer bars is to reduce the probability of a valid but erroneous short read of the symbol where a scanning beam enters and/or leaves the symbol at the top or bottom. Bearer bars should be added unless technical constraints prevent it or unless the reading or data processing equipment is programmed for fixed length symbols. In open system applications where a wide range of reading environments will be encountered, bearer bars should be applied as a default measure to prevent short reads.

Bearer bars when used should be placed perpendicular to the bars in the symbol, abutting the top and the bottom of the symbol bars over the full length of the symbol. They may extend over the quiet zones and may also be extended to form a frame around the symbol inclusive of the minimum quiet zones.

The use of a data check digit can also reduce (by a factor of ten) the risk of data from a short read being accepted by the host system.

4.4.1.2 Two dimensional symbols

The following two dimensional symbologies are European and International Standards:

a) "Code 16k" Symbology (EN 12323)

b) "PDF 417" Symbology (EN ISO/IEC 15438)

c) "Datamatrix" Symbology (ISO/IEC 16022)

d) "QR Code" Symbology (ISO/IEC 18004)

e) "Maxicode" Symbology (ISO/IEC 16023)

Where large sized high capacity two dimensional symbols are used in an application, the impact on the data processing system of sorting the large amount of data which is decoded from a single symbol should be taken into consideration in the development of the application

NOTE Annex B compares the features of two dimensional symbologies standardised by CEN and ISO/IEC.

4.4.2 Number of symbologies to be used

The number of symbologies to be specified for use by an application standard shall be carefully considered. The use of autodiscrimination in an application where a number of different symbologies are in use can increase the risk of reading errors with resultant corruption of the database. The number of symbologies employed in an application and enabled in the reading equipment should therefore be limited to the minimum required to operate that application efficiently.

If the use of more than one symbology is unavoidable, then the following recommendations should be applied:

a) segregate the use of the different symbologies to different parts of the application, and set decoders to decode only the symbology specified for that part of the application.

b) use symbology identifiers in accordance with ISO/IEC 15424 to ensure that the system can be programmed to recognise the symbology from which the data originated.

c) apply other checks to the data decoded such as format, string length, data check character and symbol check character validations, to ensure that the integrity of the data decoded is maximised.

NOTE Large capacity 2D symbols have a number of security features which are incorporated into every symbol, the points mentioned in c) are principally intended for use in applications where linear symbols are used.

4.4.3 Symbol security

4.4.3.1 Linear symbols

In order to ensure the integrity of data decoded from symbols, provision should be made for the use of a symbol check character in symbologies where these are an optional feature of the symbology, or, in the absence of a symbol check character, for the use of a data check character (using for example one of the types described in ISO/IEC 7064).

Systems considerations set out in the relevant symbology standards shall be applied where appropriate, to maximise the security of the reading and decoding of symbols.

4.4.3.2 Two dimensional symbols

All two dimensional symbols have symbol check characters which ensure a very high level of data security. Most two dimensional symbologies also have error correction capabilities which can correct errors or erasures in the symbols, which are introduced by printing defects or caused by damage to the symbol after printing. The level of error correction applied to some two dimensional symbols can be adjusted: in applications where a high level of security is necessary, a high level of error correction should be specified. Application of error correction to a two dimensional symbol has the effect of increasing the non-data overhead of the symbol.

4.4.4 Aspect ratio of symbols

4.4.4.1 Linear symbols

The application specification may specify the overall space requirements for symbols on items, packaging or labels. Where it does so, the standard should ensure that the height to width ratio of the symbol will not be reduced to less than the minimum specified by the standard for that symbology.

4.4.4.2 Two dimensional symbols

For multi-row bar code symbols the minimum aspect ratios or Y dimensions for the rows of the symbol shall conform with the requirements of the European or International Symbology Standard for that symbology.

The aspect ratio of multi-row bar code symbols is influenced by a number of factors, these include:

a) the manner in which the number of rows and columns to be used in the construction of the symbol is specified.

b) whether or not the number of columns in a PDF 417 symbol is specified prior to the encoding operation being commenced.

c) for Datamatrix symbols the aspect ratio is dependent on whether the application permits rectangular symbols to be used.

4.4.5 Symbol X dimensions

The range of X dimensions permitted in an application shall be specified by the application standard. Consideration should be given to ensuring that the range of X dimensions specified is compatible with:

a) the print resolution of appropriate bar code printing equipment. I.e. the widths of the elements shall be consistent integer multiples of the printer pixel width.

b) the optical resolution of appropriate scanning equipment.

In determining the X dimensions of symbols to be used in an application it should be noted that the symbology specification for some symbologies permits only one X dimension for applications of that symbology. In other cases the largest and smallest X dimensions which may be used are limited by the symbology specification.

Any pre-existing open system with which an application specification must comply must be considered when determining the range of X dimensions which may be permitted in the application.

4.4.6 Wide to Narrow Ratio

Where an application standard specifies the use of a two width symbology, acceptable ratios of wide to narrow elements shall be specified. ISO/IEC Symbology Standards for two width symbologies, specify ratios in the range 2.0:1 to 3.0:1. The application standard may specify a single ratio or a range of ratios within the 2.0:1 to 3.0:1 limits, it shall never be less than that set out in the standard for that symbology.

NOTE The smaller ratios may not be suitable where the X dimension is small: refer to the symbology standards for precise details.

4.4.7 Other Factors Influencing Symbol Specification

Other factors which should be considered when specifying the symbols which are to be used for a particular application include:

a) the types of scanner which will be used in the application.

b) where conveyor mounted scanners are used, conveyor speed and orientation of the symbol to the scanners shall be considered when specifying the symbol dimensions with

    1) the symbol length;

    2) the bar height of the symbol.

c) special conditions relating to the environment in which symbols are to be scanned should be considered. Conditions such as direct sunlight, long range reading, surfaces which are wet, frosted or unusually lit, may require special substrates or printing methods and careful consideration of symbol size to ensure good scanning performance.

d) substrates or printing techniques which may cause wide variations of print quality may limit the choice of symbologies which are suitable for that application.

e) some applications of two-dimensional symbols require special consideration of the illumination required for the reading of the symbol due to the way in which the elements of the symbol are formed, (e.g. peening or engraving into metal or plastic surfaces). The types of readers required for such applications need special consideration if the reading of the symbols is to be achieved successfully, application specifications should provide advice to the user where such symbols must be used.

4.5 Optical Parameters

4.5.1 Introduction

Bar code symbols encode information which is machine readable. In order that the encoded information can be read and correctly interpreted by bar code readers, it is essential that the symbols meet the technical requirements of the readers. These principally involve ensuring that the symbol production methods employed, and the bar code readers used, are compatible.

4.5.2 Scanner Light Source

The light source which illuminates the bar code symbol during reading will produce light at a particular wavelength or over a particular bandwidth of wavelengths. The application specification shall specify the particular wavelength of light to be employed by the bar code scanners used for that application. Care should be taken when choosing special light sources.

Where it is a requirement of the application that more than one wavelength of light may be employed, these shall be specified, e.g “633 nm and 900 nm”. They shall not be specified in terms similar to “633 nm to 900 nm”. The most commonly employed light sources and the wavelengths at which they emit light are, at the time of writing of this standard.

— Helium neon laser, red light	633 nm
— Visible laser diode, red light	675 nm
— Near infra-red laser diode, not visible	780 nm
— Light emitting diode, red	635 nm to 660 nm
— Light emitting diode near infra red to infra red, not visible	720 nm to 950 nm

NOTE 1 A few bar code scanners employ white light sources, with filters on the return path of the optical system to convert the returned light to the wavelength most suitable for the optical detector used in the scanner.

NOTE 2 Camera or vision systems used for the reading of bar code symbols, most often employ white light, though for some special applications where fluorescent or phosphorescent inks are used, the light source may be ultra-violet.

4.5.3 Symbol Production

The method of production used for bar code symbols, shall produce symbols which are compatible with the wavelength of light specified for the bar code readers used in that application.

It is particularly important that where wavelengths of light in the infra-red or near infra-red range are specified for the readers to be used in an application, that the symbol production methods selected, shall produce symbols with sufficient contrast at the selected wavelength. The symbols for use in an application shall be produced by a systematic method which assures the maintenance of minimum required standards of symbol quality, or be subject to quality control of the symbols according to EN ISO/IEC 15416.

4.5.4 Matching the Symbol and the Reader

For each application, the requirements of the reading of the symbols shall be considered in determining the symbol specification. The application standard shall ensure that proper guidance is provided to its users, relating to the correct methods of specifying bar code symbol production methods and equipment and the bar code reading systems, to ensure that the X dimensions of symbols are matched to the characteristics and optical specifications of the scanners used in that application.

NOTE The use of unmatched symbol production or reading methods will reduce the reliability of the system due to the introduction of excessive optical noise, or reduced ability to resolve the narrowest elements in the bar code symbol.

4.5.5 Quiet Zones

Application standards shall strongly emphasise that the Quiet Zones are an integral part of the bar code symbol and that under no circumstances shall any other printed matter be permitted to intrude into the Quiet Zones. The application standard shall also specify that the Quiet Zones of bar code symbols shall conform with the requirements of the appropriate CEN and ISO/IEC Symbology Standard.

NOTE Where more than one symbology is used it is recommended that the quiet zones should be as large as possible without it affecting the symbology specification.

4.6 Symbol quality

4.6.1 Introduction

The application standard shall specify a means by which symbol quality is controlled. This may be by specifying systematic production methods for the symbols, which will provide assured symbol quality, or by specifying appropriate test methods such as those defined by ISO/IEC Standards.

4.6.2 Linear symbol quality

For the quality control of linear bar code symbols is EN ISO/IEC 15416, specifies test methods and a symbol quality, grading scheme. Where the use of EN ISO/IEC 15416 is specified, an acceptable symbol grade shall be specified for symbols measured according to the methods described in this standard.

NOTE The use of different symbol grades for different parts of an application, such as different production methods or different scanning environments, may be advisable.

4.6.3 Two dimensional symbol quality symbol quality

Two dimensional symbols of two types are standardised by CEN and ISO/IEC, one type is the multi-row bar code symbol e.g. PDF 417, the other is the matrix symbol e.g. Data matrix.

For the quality control of multi-row bar code symbols, the test methods and grading of symbol quality is based upon the methods defined in EN ISO/IEC 15416. An additional graded parameter, unused error correction, is required to be measured in two dimensional symbols, the measurement method and grading of this parameter are described in ISO/IEC 15415.

For the quality control of two dimensional matrix symbols, ISO/IEC 15415 specifies test methods and a symbol quality, grading scheme. Where the use of ISO/IEC 15415 is specified, an acceptable symbol grade shall be specified for symbols measured according to the methods described in that standard.

NOTE The use of different symbol grades for different parts of an application, such as different production methods or different scanning environments, may be advisable.

4.7 Symbol Application

In an of application where more than one bar code of the same symbology encoding different data is used, the standard shall have rules which clearly differentiate the purpose each symbol, ISO/IEC 15418 defines techniques for doing this.

4.8 Labels

4.8.1 Introduction

Where symbols are not directly marked onto an item, a label may be used as an intermediate carrier for the bar code symbol or symbols, and human readable information.

4.8.2 Transport Applications

Applications which involve the marking of goods for transportation, shall use EN 1573 as the basis of this part of the application standard.

4.8.3 Non Transport Application

For applications or parts of applications not involving transportation, the size of the label, the number of bar coded human readable fields which are compulsory, and the number of each which are optional, shall be clearly described.

The use of each field shall be defined by the standard as shall the requirements for fixed or variable lengths of data in a field.

The layout of both bar coded and human readable fields, shall be clearly described by the specification, as shall the orientation of the fields relative to the intended base line of the label.

4.9 Positioning of the Symbols

Due consideration shall be given to the circumstances in which symbols on items will be required to be read. The position of the symbol on the item will be more critical if an unattended, conveyor mounted scanner is to be used. Where human intervention in scanning is intended, symbol position is less critical, however the scanning operation will be more efficient if operators know that symbols will usually be placed in particular locations.

4.10 Environmental Conditions

4.10.1 Introduction

The application standard shall provide assistance to its users in specifying methods by which the readability of symbols may be retained, under the environmental conditions which the symbol will encounter during its normal life cycle.

4.10.2 Symbol Abrasion

Symbols may be damaged by abrasion during the mechanical handling of items, or by the rubbing together of surfaces due to the motion of items relative to one another, during transportation. The application standard should be informative to its user, about the risk of such degradation of symbol quality.

The correct selection of symbol location and the use of protective laminates may be advisable in some applications.

For applications which use high capacity two dimensional symbols the application standard should provide advice on the level of error correction which shall be applied to the symbol, to compensate for damage likely to be incurred by symbols in that application. The level of error correction applied should also be based upon the required level of security for that application.

4.10.3 Other Factors

After the symbol has been printed, other production processes may effect its readability e.g. shrink wrapping or steam cleaning of containers. The application standard shall be informative to its users about the risk of such degradation of symbol quality and should specify ways of reducing this.

4.10.4 Scanning Methods

Bar code scanners which require contact with the bar code symbol during the scanning process, e.g. wand scanners, can cause degradation of the symbol. The printing method, number of points at which scanning is required and any post printing protection applied to the symbol, will all reduce the occurrence of symbol damage. The users of application standards, should be provided with guidance on any features of their application which will cause the degradation of symbols and which may therefore require durable print methods to be used, or post printing protection to be applied.

4.11 Health and Safety Considerations

Application standards shall draw the attention of its users, to any matters which require specific attention to consideration of health and safety. These shall include conformance to laser safety requirements, hazard warning labelling requirements and requirements relating to equipment safety.

NOTE EN 60825–1 provides information on the use of equipment which uses laser light sources.

4.12 Global Environmental Considerations

Application standards shall draw the attention of users to the need to use materials and processes which are sustainable and which minimise the risk of damage to the environment.

Annex A
(informative)

Symbology character sets

A.1 Introduction

One of the distinguishing features of bar code symbologies, are the range of characters which they can encode. For the symbologies currently standardised by CEN the character sets encodable are defined here.

A.2 ISO/IEC 15420 Information technology — Automatic identification and data capture techniques — Bar code symbology specification — EAN/UPC

For this symbology the encodable characters are:

— the numeric values of 0 to 9 (ASCII values 48 to 57 inclusive, in accordance with ISO/IEC 646:1991).

A.3 ISO/IEC 15417 Information technology — Automatic identification and data capture techniques — Bar code symbology specification — Code 128

For this symbology the encodable characters are:

— 128 ASCII characters (ASCII values 0 to 127 inclusive, in accordance with ISO/IEC 646:1991).

— 128 extended ASCII characters (ASCII values 128 to 255 inclusive, in accordance with ISO/IEC 8859-1:1998).

A.4 ISO/IEC 16388 Information technology — Automatic identification and data capture techniques — Bar code symbology specification — Code 39

For this symbology the encodable characters are:

— the alphanumeric characters A to Z and 0 to 9 (ASCII values 65 to 90 inclusive and 48 to 57 inclusive, in accordance with ISO/IEC 646:1991).

— seven special characters space $ % + - . / (ASCII values 32, 36, 37, 43, 45, 46 and 47 respectively, in accordance with ISO/IEC 646: 1991).

NOTE Encodation of other ASCII character values in the range 0 to 127 inclusive, in accordance with ISO/IEC 646:1991, can be achieved using a procedure which requires two bar code characters per encoded data character.

A.5 ISO/IEC 16390 Information technology — Automatic identification and data capture techniques — Bar code symbology specifications — Interleaved 2 of 5

For this symbology the encodable characters are:

— the numeric values 0 to 9 (ASCII values 48 to 57 inclusive, in accordance with ISO/IEC 646:1991)

A.6 EN 12323 Bar coding-Symbology specification Code 16K

For this symbology the encodable characters are:

— 128 ASCII characters (ASCII values 0 to 127 inclusive, in accordance with ISO/IEC 646:1991).

— 128 extended ASCII characters (ASCII values 128 to 255 inclusive, in accordance with ISO/IEC 8859 -1:1998).

A.7 EN ISO/IEC 15438 Information technology — Automatic identification and data capture techniques — Bar code symbology specification — PDF417

For this symbology the encodable characters are:

— 128 ASCII characters (ASCII values 0 to 127 inclusive, in accordance with ISO/IEC 646:1991).

— 128 extended ASCII characters [ASCII values 128 to 255 inclusive, in accordance with PC437].

— supports the AIM Global ECI Standard, permitting other character sets and data formats to be encoded.

NOTE A reference to the source of Codepage 437 can be found in the Bibliography [1]

A.8 ISO/IEC 16022 Information technology — Automatic identification and data capture techniques — Bar code symbology specification — Data matrix

For this symbology the encodable characters are:

— 128 ASCII characters (ASCII values 0 to 127 inclusive, in accordance with ISO/IEC 646:1991).

— 128 extended ASCII characters (ASCII values 128 to 255 inclusive, in accordance with ISO/IEC 8859-1:1998).

— supports the AIM Global ECI Standard, permitting other character sets and data formats to be encoded.

A.9 ISO/IEC 16023 Information technology — Automatic identification and data capture techniques — Bar code symbology specification — MaxiCode

For this symbology the encodable characters are:

— 128 ASCII characters (ASCII values 0 to 127 inclusive, in accordance with ISO/IEC 646:1991).

— 128 extended ASCII characters (ASCII values 128 to 255 inclusive, in accordance with ISO/IEC 8859-1:1998.

— supports the AIM Global ECI Standard, permitting other character sets and data formats to be encoded.

A.10 ISO/IEC 18004 Information technology — Automatic identification and data capture techniques — Bar code symbology specification — QR Code

For this symbology the encodable characters are:

— the alphanumeric characters A to Z and 0 to 9 (ASCII values 65 to 90 inclusive and 48 to 57 inclusive, in accordance with ISO/IEC 646:1991).

— nine special characters space $ % * + - . / : (ASCII values 32, 36, 37, 42, 43, 45, 46 , 47 and 58).

— 8-bit byte set in accordance with JIS X 0201 (Latin and Kana Characters)

— Kanji characters (Shift JIS values 8140hex - 9FFChex and E040hex – EA9Ehex. These are values shifted from those of JIS X 0208).

Annex B
(informative)

Symbology features

There are four bar code symbologies which are currently European and/or International Standards, each of these has its own characteristics and features. As an aid to those preparing application standards, the characteristics and features of these symbologies are shown in table B.1.

Table B.1 — Symbology features

FEATURES		SYMBOLOGY			
		"Code 128" ISO/IEC 15417	"Code 39" ISO/IEC 16388	"EAN/UCC" ISO/IEC 15420 [a]	"Int. 2 of 5" ISO/IEC 16390
Character Set Encodable [b]	Numeric	YES	YES	YES	YES
	Alphanumeric	YES	YES	NO	NO
	ASCII	YES	YES	NO	NO
Symbol Check Character	Compulsory	YES	NO	YES	NO
	Optional	NO	YES [c]	NO	YES [c]
Character Self Checking		YES	YES	YES	YES
Variable Length		YES	YES	NO [d]	YES [e]
Length in x dim. to encode 13 characters	Numeric	112	239	95	135
	Alphanumeric	178	239	NA	NA
	ASCII	178	447	NA	NA
Non Data Overhead in x [f]		35x	x[45+(c-1)]	18x	18x
Symbol Characteristics	Discrete [g]	NO	YES	NO	NO
	2 width	NO	YES	NO	YES

[a] See 4.4.

[b] See Annex A.

[c] See 4.4.4.

[d] EAN symbology and the associated UPC symbology use fixed length symbols, these are:
- EAN-13 encoding 13 digits
- EAN-8 encoding 8 digits
- UPC-A encoding 12 digits
- UPC-E encoding 12 digits in 6 symbol characters
- 2 digit add-on encoding 2 digits
- 5 digit add-on encoding 5 digit

When used in accordance with EAN General Specification, two digit or five digit add-on symbols may be used in combination with EAN-13, UPC-A or UPC-E symbol

[e] "Interleaved 2 of 5" symbols can only encode even numbers of digits. The use of variable length "Interleaved 2 of 5" symbols should be avoided, see section 4.4.1.

[f] For the purposes of calculation the following parameters are used.
- For Code 39 and Interleaved 2 of 5, the wide to narrow ratio is set at 3:1.
- For Code 39 an inter-character gap of 1 x is used.
- Quiet zones are not included.
- C = the number of characters including start and stop characters.
- For Code 39 and Interleaved 2 of 5, the non data overhead includes 1 symbol check character

[g] Discrete symbologies may be printed by mechanical numbering box methods, whereas continuous symbologies may not.

There are five bar two dimensional symbologies which are currently European and/or International Standards, each of these has its own characteristics and features. As an aid to those preparing application standards, the characteristics and features of these symbologies are shown in table B.2.

Table B.2 — Two dimensional symbology features

FEATURES		SYMBOLOGY				
		"Code 16K" EN 12323	"PDF 417" EN ISO/IEC 15438	"Data Matrix" ISO/IEC 16022	"MaxiCode" ISO/IEC 16023	"QR Code" ISO/IEC 18004
Character Set Encodable [a]	Numeric	YES	YES	YES	YES	YES
	Alphanumeric	YES	YES	YES	YES	YES
	Extended ASCII 128 - 256	ISO/IEC 8859-1:1998	PC437	ISO/IEC 8859-1:1998	ISO/IEC 8859-1:1998	
	ASCII 0-127	ISO/IEC 646:1991	ISO/IEC 646:1991	ISO/IEC 646:1991	ISO/IEC 646:1991	
	Other character sets	NO	YES	YES	YES	YES
	Supports ECI's	NO	YES	YES	YES	YES
Error checking		YES	YES	YES	YES	YES
Error correcting		NO	YES	YES	YES	YES
Variable length		YES	YES	YES	NO [b]	YES
Symbol type	Multi-row	YES	YES			
	Matrix			YES	YES	YES
Symbol size		Variable	Variable	Variable	Fixed	Variable
Data characters per symbol for maximum symbol size.	Numeric	154	2710	3116	138	7366
	Alphanumeric	77	1850	2335	93	4464
	ASCII	77	1108	1556	93	3069

[a] See Annex A.

[b] Maxicode symbols encode 93 data characters when the standard error correction scheme is used and 77 data characters when the enhanced error correction scheme is used. To obtain a symbol of uniform size any unused data character positions are filled with pad characters.

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AIM : ECI – Part 1 *AIM Global Technical Specification: Extended Channel Interpretations — Part 1: Identification Schemes and Protocol.*

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

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