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Packaging — Linear bar code and two-dimensional symbols for product packaging

Emballages — Code-barres linéaire et symboles bidimensionnels pour l'emballage de produits

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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

Technical Committee 122, *Packaging,* prepared ISO 22742.1

This second edition cancels and replaces the first edition (ISO 22742:2005).

This standard is based on ANS MH10.8.6, GS1 General Specifications, and standards on product packaging (e.g. IEC 62090).

Introduction

Bar code marked product package labels are in widespread use in global industries. A number of different standards exist each designed to meet the requirements of the specific industry sector. For effective and economic use within and between industry sectors, one common multi-industry standard is a necessity.

A bar code marked product package label is designed to facilitate the automation of inventory, distribution, repair and point of purchase operations. The bar code information on the product package label may be used as a key to access the appropriate database, which contains detailed information about the product including information transmitted via EDI. In addition, a product package label may contain other information as agreed between the trading partners.

Two-dimensional symbols may be included to assist moving greater amounts of product data from sender to recipient.

Whereas ISO 15394 is intended to support the transportation function within the supply chain (e.g. from the shipping dock, through the transportation processes, and to the receiving dock), this International Standard is intended to support the logistic functions preceding and following transportation. At the origin point, this International Standard is designed for use from manufacture to storage, to picking and packing, to delivery to the shipping dock, and all associated inventory processes. At the destination point, it is designed for use from the receiving dock to order checking, to storage, to consumption, and to all associated inventory processes and reverse logistic processes.

Packaging — Linear bar code and two-dimensional symbols for product packaging

1 Scope

This International Standard

a) Specifies the minimum requirements for the design of labels containing a linear bar code and two-dimensional symbols on product packages to convey data between trading partners,

b) Provides guidance for the formatting on the label of data presented in a linear bar code, two-dimensional symbols or human-readable form,

c) Provides specific recommendations regarding the choice of linear bar code and 2D symbologies, specifies quality requirements and classes of bar code density,

d) Provides specific recommendations regarding 2D symbologies, which allow a broad choice for general use of scanning hardware (e.g. area imagers, linear imagers, single-line laser scanners, and rastering laser scanners), and

e) Makes recommendations as to label placement, size and the inclusion of free text and any appropriate graphics.

This International Standard supports item identification and supply chain processes, at the product package level, such as inventory control, picking, and point of use.

NOTE ISO 15394 supports the distribution and transportation business processes, so aiding the tracing and tracking of unique shipments.

The purpose of this International Standard is to establish the machine-readable (e.g. bar code) and human-readable data content of labels applied to product packages.

Intended applications include, but are not limited to, inventory, warehouse management, maintenance and point of purchase.

While guidance is provided, specific label dimensions or marking areas, and the location of the information are not defined in this International Standard. Before implementing this specification, suppliers and manufacturers are advised to review and mutually agree on these details with their trading partners.

This International Standard does not supersede or replace any applicable safety or regulatory marking or labelling requirements. It is intended to satisfy the minimum product package requirements of numerous applications and industry groups. As such, its applicability is to a wide range of industries, each of which may have specific implementation guidelines. This International Standard is applicable in addition to any other mandated labelling requirements.

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.

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

ISO 21067, *Packaging — Vocabulary*

ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

ISO/IEC 15417, *Information technology — Automatic identification and data capture techniques — Bar code symbology specification — Code 128*

ISO/IEC 15418, *Information technology — GS1 Application Identifiers and ASC MH 10 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 15434, *Information technology — Automatic Identification and Data Capture Techniques — Syntax for High Capacity ADC Media*

ISO/IEC 15438, *Information technology — Automatic identification and data capture techniques — Bar code symbology specifications — PDF417*

ISO/IEC 15459-2, *Information technology — Unique identifiers — Part 2: Registration procedures*

ISO/IEC 16022, *Information technology — International symbology specification — Data Matrix*

ISO/IEC 16388, *Information technology — Automatic identification and data capture techniques — Bar code symbology specifications — Code 39*

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 — QR Code 2005 bar code symbology specification*

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

ANS MH10.8.2, *Data Application Identifiers*

ANS HIBC 2, *Health Industry Supplier Labeler Standard*

GS 1 General Specifications

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 19762, ISO 21067, and the following apply.

3.1
Code 39
3 of 9 Code (deprecated)
discrete, variable length, bar code symbology encoding the characters 0 to 9, A to Z, and the additional characters "-" (dash), "." (period), space, "$" (dollar sign), "/" (slash), "+" (plus sign), and "%" (percent sign), as well as a special symbology character to denote the start and stop character, conventionally represented as an "*" (asterisk)

NOTE Each Code 39 symbol consists of a leading quiet zone, a start symbol pattern, symbol characters representing data, a stop pattern, and a trailing quiet zone. Each Code 39 character has three wide elements out of a total of nine elements. Each symbol consists of a series of symbol characters, each represented by five bars and four intervening spaces. Characters are separated by an intercharacter gap. Each element (bar or space) is one of two widths. The values of the X dimension (3.13) and wide-to-narrow ratio remain constant throughout the symbol. The particular pattern of wide and narrow elements determines the character being encoded. The intercharacter gaps are spaces with a minimum nominal width of 1X. See ISO/IEC 16388 for the Code 39 symbology specification.

3.2
Code 128
continuous, variable length, bar code symbology capable of encoding the full ASCII-128 character set, the 128 extended ASCII character set, and four non-data function characters

NOTE Code 128 allows numeric data to be represented in a compact double-density mode, with two data digits for every symbol character. Each Code 128 symbol uses two independent self-checking features, character self-checking via parity and a modulo 103 check character. Each Code 128 symbol consists of a leading quiet zone, a start pattern, characters representing data, a check character, a stop pattern, and a trailing quiet zone. Each Code 128 character consists of eleven 1X wide modules. Each symbol character is comprised of three bars alternating with three spaces, starting with a bar. Each element (bar or space) can consist of one to four modules. Code 128 has three unique character sets designated as Code Set A, B and C. Code set A includes all of the standard upper-case alphanumeric keyboard characters, the ASCII control characters having an ASCII value of 0 to 95, and seven special characters. Code set B includes all of the standard upper-case alphanumeric keyboard characters, lower-case alphabetic characters (specifically ASCII character values 32 to 127), and seven special characters. Code set C includes the set of 100 digit pairs from 00 through 99, inclusive, as well as three special characters. The FNC1 character in the first character position after the start code of Code 128 designates that the data that follows complies with the GS1-128 standards. See ISO/IEC 15417 for the Code 128 symbology specification.

3.3
component
part, assembly or raw material that is a constituent of a higher-level assembly

3.4
component packaging
commercial unit of **components** (3.3) defined by the supplier, including, if applicable, their means for protection, structured alignment or for automated assembly

NOTE Component packaging may include: a) leaded components taped on reels or in ammo boxes according to IEC 60286-1 and IEC 60286-2; b) surface mount devices (surface mount components), taped on reels according to IEC 60286-3 and in bulk case IEC 60286-6; c) integrated circuits (ICs) in stick magazines according to IEC 60286-4, or in matrix trays according to IEC 60286-5. Compare **product package** (3.32).

3.5
country of origin
manufacturing country wherein the product obtained its present identity as a part, subassembly or finished product

3.6
data element separator
specified character used to delimit discrete fields of data

3.7
data element title
part of the data area title for linear code that gives a brief description of the data element

EXAMPLES Part number and customer number.

NOTE The data element may contain abbreviations.

3.8
Data Matrix
error correcting two-dimensional matrix symbology, capable of encoding various character sets including strictly numeric data, alphanumeric data and all ISO/IEC 646 (ASCII) characters, as well as special character sets

NOTE 1 International Data Matrix developed Data Matrix in 1989 with finalized design in 1995.

NOTE 2 The symbology has **error detection** (3.16) and **error correction** (3.15) features. Each Data Matrix symbol consists of data regions that contain nominally square modules set out in a regular array. A dark module is a binary 1 and a light module is a binary 0. There is no specified minimum or maximum for the X or Y dimension. The data region is surrounded by a finder pattern that is surrounded by a quiet zone on all four sides of the symbol. The finder pattern is a perimeter to the data region and is one module wide. Two adjacent sides are solid dark lines used primarily to define physical size, orientation and symbol distortion. The two opposite sides are made up of alternating dark and light modules. These are used primarily to define the cell structure but can also assist in determining physical size and distortion. The intellectual property rights associated with Data Matrix have been committed to the public domain. See ISO/IEC 16022 for the Data Matrix symbology specification.

3.9
dot
localized region with a reflectance that differs from that of the surrounding surface

3.10
dot misalignment within a cell
distance between the physical centre point of a **dot** (3.9) and the cell centre point

3.11
GS1 system
specifications, standards and guidelines administered by GS1

3.12
EAN/UPC
family of bar code symbols including EAN-8, EAN-13, UPC-A, and UPC-E Bar Code Symbols, which are a fixed-length, numeric 8, 12, and 13-digit bar code symbol adopted by retail and some other industries, composed of a company prefix assigned by GS1 member organizations, a product code assigned by the manufacturer, and a modulo 10 check digit as the right-most digit

NOTE See ISO/IEC 15420 for the EAN/UPC symbology specification. See also **UPC-A** (3.43).

3.13
element width
"X" dimension
thickness of an element, measured from the leading edge of an element to the trailing edge of the same element

3.14
erasure correction
use of the **error correction** (3.15) characters to correct data errors that have known locations

NOTE These locations can have insufficient contrast in the image, can fall outside of the image field, or can have incorrect parity for symbologies with symbol character parity. Only one error correction character is required to correct each erasure.

3.15
error correction
mathematical procedure that allows the detection and rectification of errors to take place

3.16
error detection
use of the **error correction** (3.15) characters to detect the fact that the number of errors in the symbol exceeds the error correction capacity

NOTE Error detection will keep the symbol from being decoded as erroneous data. The error correction algorithm can also provide error detection by detecting invalid error correction calculation results.

3.17
European Norm
EN
standard of the European Union

3.18
first level assembly
manufactured item or a mechanical assembly of an item comprised of **components** (3.3)

3.19
format
high-capacity ADC medium comprising one or more **segments** (3.34)

NOTE A format contains one **format type** (3.24)

3.20
format envelope
that which delimits the start and end of data in a given **format** (3.19), consisting of a **format header** (3.21) and a **format trailer** (3.23)

3.21
format header
string of characters, including the **format indicator** (3.22), used to identify the start of a format **envelope** (3.20)

3.22
format indicator
two-digit numeric code used to identify the specific **format type** (3.24) of the application data

3.23
format trailer
character used to identify the end of a **format envelope** (3.20)

3.24
format type
rules under which a specific **format** (3.19) is encoded

3.25
GTIN
Global Trade Item Number
term for all valid GS1 Trade Item numbers (products or services)

3.26
Interleaved Two of Five
ITF
bar code symbology where two characters are paired, using bars to represent the first character and the interleaved spaces to represent the second character, encoding the ten digits 0 through 9

NOTE Each character has two wide elements and three narrow elements for a total of five elements. This is most commonly represented in the GS1 ITF-14. See ISO/IEC 16390 for the Interleaved Two of Five symbology specification.

3.27
ITF-14
14-digit implementation of the GS1 Global Trade Item Number (3.25) when encoded in the **Interleaved Two of Five** (3.26) symbology

NOTE The 14-digit version of the GTIN was formerly known as the U.P.C. Shipping Container Symbol (SCC-14).

3.28
message envelope
that which delimits the start and end of a data stream in a given message, consisting of **message header** (3.29) data and a **message trailer character** (3.30)

3.29
message header
string of characters used to identify the start of a **message envelope** (3.28)

3.30
message trailer character
End of Transmission character, “EOT”, '', (ASCII/ISO/IEC 646 Decimal “04”) (ASCII/ISO/IEC 646 Hex “04”) which serves to define the end of a message

3.31
PDF417
error correcting two-dimensional multi-row symbol

NOTE 1 Developed in 1992 by Symbol Technologies, PDF417 symbols are constructed from 4 bars and 4 spaces over 17 modules.

NOTE 2 The symbol size is from 3 to 90 rows. There is no specified minimum or maximum for X or Y dimension. With at least the recommended minimum level of **error correction** (3.15), the recommended Y dimension is 3X. With less than the minimum recommended level of error correction, the recommended Y dimension is 4X. A quiet zone of 2X is specified on each side of a symbol. Because of delta decode techniques, the symbology is immune from uniform bar width growth. PDF417 supports cross-row scanning. The intellectual property rights associated with PDF417 have been committed to the public domain. See ISO/IEC 15438 for the PDF417 symbology specification.

3.32
product package
first tie, wrap or container of a single item or quantity thereof that constitutes a complete identifiable pack

NOTE A product package may be an item packaged singularly, multiple quantities of the same item packaged together, or a group of parts packaged together. For the purposes of this International Standard, the term “product package” includes component packages and packaging intended for storage and transport.

3.33
QR Code
error correcting matrix symbology, consisting of an array of nominally square modules arranged in an overall square pattern, including a unique finder pattern located at three corners of the symbol and intended to assist in easy location of its position, size and inclination

NOTE 1 Introduced in 1994 by Denso Corporation.

NOTE 2 A wide range of sizes of symbol is provided for together with four levels of **error correction** (3.15). Module dimensions are user-specified to enable symbol production by a wide variety of techniques. The symbol size (not including the quiet zone) is 21 by 21 modules to 177 by 177 modules. The symbology efficiently encodes Kanji and Kana as well as encoding numeric, alphanumeric, and 8-bit byte data. See ISO/IEC 18004 for the QR Code symbology specification.

NOTE 3 The 2005 revision of the QR Code specification is entitled, ISO/IEC 18004, *Information technology — Automatic identification and data capture techniques — QR Code 2005 bar code symbology specification*

3.34
segment
logical group of data elements, specifically, a logical portion of an EDI or high capacity ADC message

3.35
segment terminator
single character used to separate **segments** (3.34)

3.36
semantics
means by which the purpose of a field of data is identified

NOTE Semantic examples used in automatic data capture include ISO/IEC 15418/ASC MH 10 Data Identifiers, GS1 Applications Identifiers, EDI (X12/EDIFACT/CII) Data Element Qualifiers

3.37
serial number
code assigned by the **supplier** (3.39) to an entity for its lifetime

EXAMPLES Computer serial number, traceability number and contract tool identification.

3.38
structure
order of data elements in a message

3.39
supplier
party that produces, provides or furnishes an item or service

3.40
syntax
way in which data are put together to form messages

NOTE Syntax also includes rules governing the use of appropriate identifiers, delimiters, separator character(s), and other non-data characters within the message. Syntax is the equivalent to grammar in spoken language. The syntactic example used in automatic data capture includes ISO/IEC 15434/ANS MH10.8.3.

3.41
traceability identification
code assigned to identify or trace a unique group of entities (e.g. lot, batch, item, revision/version or serial number)

3.42
traceability number
code assigned by the **supplier** (3.39) to identify/trace a unique group of entities (e.g. lot, batch)

3.43
UPC-A
Universal Product Code
fixed-length, numeric 12-digit bar code symbol adopted by the retail industries, composed of a company prefix assigned by GS1, a product code assigned by the manufacturer, and a modulo 10 check digit as the right-most digit

NOTE For international compatibility with EAN-13, a 13th digit may be represented as a derived 0 in the left-most position. See ISO/IEC 15420 for the EAN/UPC symbology specification.

4 Label data content and requirements

4.1 General

Before implementing this specification, suppliers and manufacturers should review and mutually agree on specific labelling details with their trading partners. The labelling requirements of this International Standard and other standards may be combined into one label or appear as separate labels.

The label format accommodates both mandatory and optional data elements.

The number included in the character count is exclusive of overhead characters such as start and stop characters, data identifiers or application identifiers and any other characters required by a standard symbology specification to properly encode data.

All data elements encoded in a machine-readable medium shall be preceded by the appropriate Data Identifier (DI) defined in ISO/IEC 15418 and ASC MH 10 Data Identifier, or the appropriate Application Identifier (AI) defined in ISO/IEC 15418 and the GS1 General Specifications.

The choice between GS1 Applications Identifiers or Data Identifiers for any user will normally be defined in the applicable industry convention being followed.

Other industries developing product or shipment identification conventions should consider business practices, information requirements and systems capabilities of the trading partners in choosing between Data Identifiers and GS1 Applications Identifiers. The user may also consider the following guidelines.

GS1 Applications Identifiers (AIs)

The definitions of the GS1 Applications Identifiers (AIs) are supported by application guidelines. The GS1 AIs, and associated guidelines, have been designed for international and multi-sectorial trading purposes.

The GS1 item identification system and related encodation standard are complemented by the GS1-maintained Application Identifiers, hereafter referred to as “GS1 Applications Identifiers” (GS1 AIs). This standard comprises two principal elements that are the key to any encoding system: the data content and the data carrier.

The use of GS1 AIs is subject to the rules established by GS1.

GS1 AIs identify generic and simple data fields for use in cross-sectorial and international supply chain applications. The GS1 General Specifications provide rules for the definition, format and structure of the data fields.

Each GS1 AI consists of two or more characters. The first two digits determine the length of the AI. A list of two digit codes indicating the predefined length of existing and future AIs and their data fields are contained within the GS1 General Specifications.

Data Identifiers (DIs)

The descriptions in the Data Identifier list are general in nature and are used in industrial and international applications. Specific application guidelines provide the detailed definition used amongst trading partners.

The full list of registered Data Identifiers (DIs) and the full specification for their use are found in ANS MH10.8.2.

DIs may be used with any alphanumeric data carrier and are designed to ensure cross-industry commonality of data identifiers used in automatic identification technologies.

DIs have a format of one alphabetic character alone, or one alphabetic character prefixed by one, two or three numeric characters.

It is recommended that data structures used to identify products or the traceability of products include identification of the organization providing the coding as well as the specific coding structure. Such data structures include 25P, 22S, 25S, and 25T.

In the GS1 General Specifications, this coding structure is the company prefix portion of the GTIN (Global Trade Item Number) or GLN (Global Location Number).

When using Data Identifiers, this coding structure uses the Issuing Agency Code (IAC) established in ISO/IEC 15459-2 (Unique identifiers – Registration procedures) and the Company Identification Number (CIN) assigned by the issuing agency.

4.2 Rules for encoding of mandatory and optional data elements in machine-readable symbols and human-readable information

4.2.1 General rules

The choice to encode in linear bar code, 2D symbol, or both shall be agreed between trading partners.

The appropriate Data Identifier or Application Identifier shall precede all machine-readable data elements. The Data or Application Identifiers should be selected from the options given in 4.1 and shall be in accordance with ISO/IEC 15418.

4.2.2 Rules for mandatory data elements

4.2.2.1 Encoding mandatory elements in machine-readable symbols

Mandatory data elements shall be encoded in a machine-readable symbol, as follows.

a) If only a linear bar code is used, the mandatory data shall be in the linear bar code.

b) If both a linear bar code and 2D symbol are used on the label, the mandatory data shall be in the linear bar code and the 2D symbol.

c) If only a 2D symbol is used, the mandatory data shall be in the 2D symbol.

4.2.2.2 Human-readable information for encoded data elements

Human-readable information for mandatory data elements shall be on the label in all cases, as follows.

a) For linear symbols, the human-readable shall be human-readable interpretation.

b) For 2D symbols, the human-readable shall be human translation.

When mandatory data are only in the 2D symbol, the mandatory human-readable shall be human translation.

4.2.3 Rules for additional data elements[1]

4.2.3.1 Encoding in machine-readable symbols

Additional data elements should be encoded in a machine-readable symbol, as follows.

a) If only linear bar codes are used, the data should be in the linear bar code.

b) If both linear bar codes and the 2D symbol are used:

— Data should be in the linear bar code and should be included in 2D;

— If the data are included in the linear bar code, the data shall also be included in the 2D symbol.

[1] Additional" data elements are defined in 4.3.

c) If only a 2D symbol is used, the data should be in the 2D symbol. The use of a 2D symbol shall be accompanied by the linear bar code of the mandatory data fields unless mutually agreed upon between trading partners.

4.2.3.2 Human-readable information for encoded data elements

Human-readable information for optional data elements encoded in a linear symbol shall be on the label in all cases. In this case, human-readable interpretation shall be present and human translation may be added.

For data elements encoded in 2D symbols, the human-readable information should be on the label and it shall be human translation.

4.2.3.3 Human-readable information for data elements not encoded

Human-readable information for additional data elements that are not encoded in machine-readable symbols may be shown in human-readable information only.

4.2.4 Rules for data elements not specified in this International Standard

4.2.4.1 Encoding additional data elements in machine-readable symbols

— If only linear bar codes are used, the data may be in the linear bar code.

— If both linear bar codes and 2D symbol are used:

  — Data may be in linear bar code and should be included in 2D;

  — If the data are included in the linear bar code, the data shall also be included in the 2D symbol.

— If only a 2D symbol is used, the data should be in the 2D symbol. The use of a 2D symbol shall be accompanied by the linear bar code of the mandatory data fields unless mutually agreed upon between trading partners.

4.2.4.2 Human-readable information for encoded data elements

For data elements encoded in a linear symbol, the human-readable information shall be on the label in all cases. In this case, human-readable interpretation shall be present and human-readable translation may be added.

For data elements encoded in 2D symbols, the human-readable information may be on the label and it shall be printed as human translation.

4.2.4.3 Human-readable information for data elements not encoded

Other data elements may be shown in free text only.

EXAMPLES Product description and parametric values.

Table 1 — Machine-readable symbols and human-readable information

Data element status	Machine-readable symbols on label	Requirement for encoding		Requirement for human-readable information
		Bar code	2D	
Mandatory	Bar code	shall		shall
	Bar Code + 2D	shall	shall	shall
	2D		shall	shall
Optional Specified (See Note)	Bar code	should		shall if encoded
	Bar Code + 2D	should [a]	should	shall if encoded in bar code
	2D		should	should if encoded
	None			may
Optional Not specified (See Note)	Bar code	may		shall if encoded
	Bar Code + 2D	may	may	shall if encoded in bar code
	2D		should	may if encoded
	None			may

NOTE In this International Standard, "Specified Optional Data Elements" are Supplier Item Identification, Country of Origin, and Date. All others belong to the category "Optional Data Elements Not Specified".

[a] If the data element is encoded in linear bar code, it shall also be included in the 2D symbol.

4.3 Basic data elements

4.3.1 General

Whether a data element is mandatory or optional is dependent on industry, market, or individual trading partner requirements. These data elements may be human-readable, machine-readable, or both. If machine-readable, the data elements shall be in accordance with ISO/IEC 15418.

Certain data elements are mandatory to a broad range of product package applications. These are

- item identification code,
- quantity without or quantity with unit of measure,
- traceability identification, and
- serial number or traceability number.

Table 2 — Data element usage

Data element	Requirement
Item identification code	Mandatory.
Quantity	Mandatory, if the package contains more than one of an item. Note that some manufacturers may change the product code to represent a change in quantity.
Traceability identification	Mandatory (unless otherwise agreed upon between trading partners).

4.3.2 Item identification

Either the supplier or the customer may assign Item identification. Either the customer item identification, or the supplier item identification, or both may be shown on the label as agreed to between the trading partners. If both are shown on the label, at least one of the two item identifiers shall be encoded in a machine-readable symbol.

The supplier's part number shall be used for item identification in the absence of a different agreement between trading partners.

The maximum length of this data element is 25 alphanumeric characters; not including the appropriate identifier (AI or DI).

The item identification data field should be in one of the formats shown in Tables 3 and 4. These identifiers represent the most frequently used formats for product package. The complete list of possible item identification codes can be found in ANS MH10.8.2 or the GS1 General Specifications.

Table 3 — DIs used in item identification

Data Identifier	Data field	Data characteristics Type/length	Description
P	Product number	an1 + an...25	Customer assigned part number.
1P	Product number	an2 + an...25	Supplier assigned part number.
3P	Product number	an2 + n12..13 + n2..5	Combined manufacturer identification code/item code under the 12/13-digit GS1 GTIN formats, plus supplemental codes, if any.
8P	Product number	an2 + n14	GS1 GTIN
11P	Product number	an3 + an10	CLEI code for telecommunications equipment.
19P	Product number	an3 + an...32	Component of an item (one product contained in multiple packages).
25P	Product number	an3 + an...32	Combined IAC/CIN and item code assigned by the supplier.
+	Product number	a1 + an...19	HIBCC

Table 4 — AIs used in item identification

Application Identifier	Data field	Data characteristics Type/length	Description
Not applicable when used in UPC-A, EAN-13, or EAN-8	Global Trade Item Number (GTIN)	n8 n12 n13 n14	Global Trade Item Number: Shorthand term for the GS1 Global Trade Item Number. A GTIN may use the GTIN-8, GTIN-12, GTIN-13 or GTIN-14 standard numbering structure.
01	GTIN	n2 + n14	GTIN identification of trade items.
02	GTIN	n2 + n14	GTIN identification of trade items contained in a logistic unit.
241	Part number	n3 + an...30	Customer assigned part number.
8001	Roll products	n4 + n14	Roll products - width, length, core diameter, direction and splices.
8006	Identification of the components of a trade item	n4 + n14 + n2 + n2	GS1 identification of a fixed measure trade item (GTIN) packed in separate parcels. (n of x)
8018	Global Service Relation Number (GSRN)	n4 + n18	GS1identification number of a service relation (GSRN) to be assigned by the service provider.
8020	Payment slip reference number	n4 + an...25	Payment slip reference number.

4.3.3 Quantity

Unless otherwise specified, the implied quantity of the product identified on the outside of the product package is one.

Two primary methods exist of identifying the quantity inside a product package.

a) The first situation is where the product package identifies the product code and the quantity contained therein on the product package label. This may be analogous to a raw material being received where ten of an item are received in the same box and the product package identifies ten products having the same product code. In this situation, the quantity would be considered to be ten.

b) The second situation is where a quantity of product and its packaging are identified by a product code different from the product code assigned to the product inside. This may be analogous to a consumable unit (e.g. batteries) where the combination of the items, quantity and packaging constitute a unique product code. In this situation, the quantity would be considered to be one.

If used, the quantity shall be the quantity in the package or container to which the label is affixed. The default unit of measure for Data Identifier "Q" is EACH or PIECES. The default unit of measure for Application Identifier "30" is EACH or PIECES (count of items).

When Data Identifiers are used and when a different unit of measure is required, as agreed between trading partners, the Data Identifier "7Q" shall be used with the quantity followed by two alphanumeric characters representing the ANS X.12.3 unit of measurement code. In the special case where multiple containers comprise a single product (the contents of each container shall be combined with the content of the other containers to constitute a single product), the Data Identifier "6Q" or Application Identifier "8006" shall be used to link the various containers.

When Application Identifiers are used and when a different unit of measure is required, as agreed to between trading partners, one of the Application Identifiers in the "3nn" series, as specified in the GS1 General Specifications, shall be used with a decimal point indicator and the quantity.

When the GS1 system is used, the identification always relates to the complete package (packaging + contents). Fixed measure trade items are those that are always produced in the same version and composition (type, size, mass, quantity of contents, design, etc.). Like a ***fixed*** measure trade item, a ***variable*** measure trade item is an entity with pre-defined characteristics (e.g. the nature of the product or its contents). Unlike a ***fixed*** measure trade item, a ***variable*** measure trade item has at least one characteristic that varies whilst other characteristics of the trade item remain the same. The variable characteristic may be mass, dimension, number of items contained or volume information. The complete identification of a variable measure trade item consists of both an identification number and information about the variable data.

The quantity data field should be in one of the formats shown in Tables 5 and 6. These identifiers represent the most frequently used formats for product package applications.

Table 5 — DIs used to identify quantity

Data Identifier	Data field	Data characteristics Type/length	Description [a]
Q	Quantity in package	an1 + n...14	The number of products (pcs) in the shipment container. EXAMPLE Q2000
2Q	Actual mass	an2 + n...14	The actual mass of package (kilograms implied by convention). (This includes an encoded decimal point, if necessary.) EXAMPLE 2Q200.1
6Q	One package over multiple containers	an2 + n...2/n...2	Where multiple containers comprise a single product (the contents of each container shall be combined with the content of the other containers to constitute a single product) to link the various containers. The format # of # ("this is the nth piece of x pieces to define the product"). Presented in the format "n/x", where the "/" (slash) is used as a delimiter between two values.
7Q	Quantity with unit of measure	an2 + n...14 + an2	The quantity with ANS X12.3 Data Element Dictionary qualifier of products in the shipment container. (CR = cubic metre) EXAMPLE 7Q1CR (This includes an encoded decimal point, if necessary.)
NOTE Print only the significant digits for the human-readable quantity. Do not print leading zero.			
[a] Examples show encoded characters. Spaces are shown for clarity but are not encoded.			

Table 6 — AIs used to identify quantity

Application Identifier	Data field	Data characteristics Type/length	Description
30	Quantity in package	n2 + n...8	Count of items contained in a variable measure trade item. EXAMPLE 302 000
3nn [b]	Quantity with specific unit of measure (with decimal point indication)	n4 + n6	Defined quantity and unit measure of the package (mass, sqm, volume, length, etc.) in a metric and non-metric system. Possible combinations of AIs: about 50. EXAMPLE 310 100 002 5 equals 2,5 kg net mass
37	Quantity in package	n2 + n...8	Count of trade items contained in a logistic unit.
NOTE For AI 30 and 37 print only the significant digits for the human-readable quantity. Do not print leading zeros.			
[a] Examples show encoded characters. Spaces are shown for clarity but are not encoded. [b] Plus one digit for decimal point indication.			

4.3.4 Traceability identification

4.3.4.1 General

The supplier shall assign the traceability identification. This category of identification includes serial numbers and lot/batch numbers.

When Data Identifiers are used, traceability identification should be either a serial number (using the Data Identifier "25S") or a lot/batch number (using the Data Identifier "1T").

When Application Identifiers are used, traceability identification should be either a serial number (using the Application Identifier "21") or a lot/batch number (using the Application Identifier "10").

In certain circumstances, both the serial number and the lot/batch number may be shown on the label. In this case at least one of the two should be encoded in a machine-readable symbol.

The maximum length of this data element is 32 alphanumeric characters, except where fixed to a lesser length by industry application standards.

The product traceability data field should be in one of the formats shown in Tables 7 and 8. These identifiers represent the most frequently used formats for product package applications.

Table 7 — DIs used for traceability information

Data Identifier	Data field	Data characteristics Type/length	Description
S	Serial No.	an1 + an...25	Serial number or code assigned by the supplier to an entity for its lifetime.
22S	Electronic serial number	an3 + an...25	Electronic serial number for cellular mobile telephones.
25S	Serial number	an3 + an...32	Combined IAC/CIN and the serial number assigned by the supplier.
1T	Lot/batch number	an2 + an...25	Lot/batch number defined by the manufacturer.
25T	Lot/batch number	an3 + an...32	Combined IAC/CIN and entity identification and lot/batch number assigned by the supplier.
+$	Lot/batch number	a2 + an..15	Options of concatenated lot/batch combinations with product data are specified in ANS/HIBC 2.

Table 8 — AIs used for traceability information

Application Identifier	Data field	Data characteristics Type/length	Description
10	Batch or lot number	n2 + an...20	Traceability code defined by the manufacturer.
21	Serial number	n2 + an...20	Serial number or code assigned by the supplier to an entity for its lifetime.
250	Secondary serial number	n3 + an...30	Secondary serial number of a component of a trade item. [a]
251	Reference to source entity	n3 + an...30	An attribute of a trade item, used to refer back to the original item the trade item was derived from.
7002	UN/ECE meat carcasses and cuts classification	n4 + an..30	United Nations (UN/ECE) meat carcasses and cuts classification.
8002	Electronic serial number	n4 + an...20	Electronic serial number for cellular mobile telephones.

[a] If this AI 250 is being used, a trade item shall be a symbol marked with the following element strings:
AI 01 representing the identification number (GTIN) of the trade item
AI 21 representing the serial number of the trade item
AI 250 representing the serial number of a component of the trade item.

4.3.4.2 Serial number

A serial number is a unique code assigned by the supplier to an entity for its lifetime. The manufacturer shall define the format for the serial number.

4.3.4.3 Traceability number

A traceability number is a code assigned by the supplier to identify or trace a unique group of entities (e.g. lot, batch).

4.4 Additional data elements

4.4.1 General

Whether a data element is mandatory or optional may be dependent on industry, market, or individual trading partner requirements. Beyond those identified in Table 2, the following data elements may find common usage. These data elements may be human-readable, machine-readable, or both. If machine-readable, the data elements shall be in accordance with ISO/IEC 15418:

— Supplier identification,

— Country of origin,

— Date element, and

— Others.

4.4.2 Supplier identification

The supplier identification shall uniquely identify the supplier to which the component is traceable. The supplier identification should be assigned by the supplier or recognized body assigning supplier identification and in mutual agreement between trading partners; it may be assigned by the customer.

It is recommended that the supplier identification shown on the label be the supplier identification assigned by the supplier or recognized body assigning supplier identification.

The maximum length of this data element is 18 alphanumeric characters.

The supplier identification field should be in one of the formats shown in Tables 9 and 10.

Table 9 — DIs used for supplier identification

Data Identifier	Data field	Data characteristics Type/length	Description
V	Vendor code	an1 + an9	Supplier code assigned by a customer.
12V	DUNS number identifying manufacturer	an3 + n9	Entity (manufacturer) identification assigned by Dun and Bradstreet.
17V	Department of Defense (DoD) CAGE code or NATO NCAGE code	an3 + an5 (CAGE) an3 + an6 (NCAGE)	Company identification assigned by the US Department of Defense or NATO.
20V	Company identification	an3 + an1..3 + an3..13 + "+" + an3	Combined IAC/CIN and party qualifier code (EDIFACT DE 3035).
18V	Company identification	an3 + an1..3 + an3..13	Combined IAC/CIN.

Table 10 — AIs used for supplier identification

Application Identifier	Data field	Data characteristics Type/length	Description
412	Supplier GLN	n3 + n13	Global Location Number: a 13-digit non-significant reference number used to identify legal entities (e.g. registered companies), functional entities (e.g. specific department within a legal entity) or physical entities (e.g. a door of a warehouse).
7030	Approval number of a slaughterhouse	n4 + n3 + an..27	Identification of the slaughterhouse including ISO country code.
7031-39	Approval number of de-boning and cutting halls	n4 + n3 + an..27	Identification of de-boning and cutting halls including ISO country code.

4.4.3 Country of origin

Human-readable marking requirements may be different and may be dependent on special country and/or industry requirements. Refer to the respective rules to apply the country of origin marking correctly. The definition of country of origin shall be in line with local jurisdictions.

If encoded in a machine-readable symbol, the ISO 3166-1 code list shall be used as shown in Tables 11 (3166-1 alpha-2) and 12 (3166-1 numeric).

When using Data Identifiers, the fixed length of this data element is two alphabetic characters.

When using Application Identifiers, the fixed length of this data element is three numeric characters.

The country of origin code field should be in the format shown in Tables 11 and 12.

Table 11 — Country of origin DI

Data Identifier	Data field	Data characteristics Type/length	Description [a]
4L	Country code	an2 + a2	2 character country code assigned by ISO. The country of origin is defined as the manufacturing country wherein the product obtained its present identity as a part, sub-assembly, or finished product. With the agreement of the trading partners and when the country of origin is mixed, country code “AA” shall be used. The alpha-2 country code is found in ISO 3166-1. EXAMPLE 4L US.

[a] Examples show encoded characters. Spaces are shown for clarity but are not encoded.

Table 12 — Country of origin AIs

Application Identifier	Data field	Data characteristics Type/length	Description [a]
422	Country of origin of a trade item (with ISO country code)	n3 + n3	3-digit country code assigned by ISO. The country of origin is defined as the manufacturing country wherein the product obtained its present identity as a part, sub-assembly, or finished product. With the agreement of the trading partners and when the country of origin is mixed, country code “000” shall be used. The numeric-3 country code is found in ISO 3166-1. EXAMPLE 422 840.
423	Country (or countries) of initial processing (with ISO country code)	n3 + n3 + n...12	ISO country codes stating the countries of initial processing of a trade item.
424	Country of processing (with ISO country code)	n3 + n3	ISO country code stating the country of processing of a trade item.
425	Country of disassembly (with ISO country code)	n3 + n3	ISO country code stating the country of disassembly of a trade item.
426	Country covering full process chain (with ISO country code)	n3 + n3	ISO country code stating the [single] country of full processing of a trade item.

[a] Examples show encoded characters. Spaces are shown for clarity but are not encoded.

4.4.4 Date elements

When used, date elements should be as defined by the supplier.

If encoded in a machine-readable symbol, date element fields should be in one or more of the formats given in Tables 13 and 14.

Table 13 — Date elements using DIs

Data Identifier	Data field	Data characteristics Type/length	Description [a]
6D	Defined date	n2 + n8 + an3	ISO format YYYYMMDD immediately followed by an ANS X12.3 Data Element Number 374 qualifier providing a code specifying type of date (e.g. ship date, manufacture date).
14D	Expiration date	n2 + n8	Expiration date (YYYYMMDD).
16D	Production date	n2 + n8	Production date (YYYYMMDD).

[a] Examples show encoded characters. Spaces are shown for clarity but are not encoded.

Table 14 — Date elements using AIs

Application Identifier	Data field	Data characteristics Type/length	Description [a]
11	Production date	n2 + n6	The production or assembly date determined by the manufacturer. The date may refer to the trade item itself or to items contained. The structure is: *Year* The tens and units of the year (e.g. 2002 = 02), which is mandatory. *Month* The number of the month (e.g. January = 01), which is mandatory. *Day* The number of the day of the relevant month (e.g. 23rd day = 23). If it is not necessary to specify the day, the field shall be filled in with two zeros. EXAMPLE 11 020 123.
13	Packaging date	n2 + n6	The date when the goods were packed as determined by the packager. The date may refer to the trade item itself or to items contained. The structure is: *Year* The tens and units of the year (e.g. 2002 = 02), which is mandatory. *Month* The number of the month (e.g. January = 01), which is mandatory. *Day* The number of the day of the relevant month (e.g. 23rd day = 23). If it is not necessary to specify the day, the field shall be filled in with two zeros. EXAMPLE 13 020 123.
15	Minimum durability date (quality)	n2 + n6	The *minimum durability date* indicates the ideal consumption or best effective use date of a product. It is a statement about *quality*. It is often referred to as a “sell by date” or a “best before date”. The structure is: *Year* The tens and units of the year (e.g. 2002 = 02), which is mandatory. *Month* The number of the month (e.g. January = 01), which is mandatory. *Day* The number of the day of the relevant month (e.g. 23rd day = 23). If it is not necessary to specify the day, the field shall be filled in with two zeros. EXAMPLE 15 020 123.
17	Packaging maximum durability date (safety)	n2 + n6	The *maximum durability date* is the date that determines the limit of consumption or use of a product. It is a statement about *safety*. It is often referred to as “use by date” or “expiry date”. The structure is: *Year* The tens and units of the year (e.g. 2002 = 02), which is mandatory. *Month* The number of the month (e.g. January = 01), which is mandatory. *Day* The number of the day of the relevant month (e.g. 23rd day = 23). If it is not necessary to specify the day, the field shall be filled in with two zeros. EXAMPLE 17 020 123.

[a] Examples show encoded characters. Spaces are shown for clarity but are not encoded.

4.4.5 Others not specified in this International Standard

Examples of this category of data elements are product description and parametric values.

4.5 Data representation

4.5.1 General formatting

Data elements can be represented on the label as human-readable information, or encoded in machine-readable symbols, or both.

The label shall consist of machine-readable data elements and human-readable data elements.

It is important that the appropriate Data Identifiers/Application Identifiers, data separators and start and stop characters are utilized in accordance with their associated industry, country, or region and symbology standards. For the purposes of this International Standard, the Data Identifiers/Application Identifiers for each data element should be selected from the options given in 4.2 and 4.3 (preferred), but in any case shall be selected from ISO/IEC 15418/ANS MH10.8.2. When long messages are created through the concatenation of multiple data fields, the syntax described in ISO/IEC 15434 shall be used.

4.5.2 General formatting for machine-readable symbols

4.5.2.1 Linear bar code syntax

Generally, it is recommended that each data element be encoded in a separate bar code symbol.

If mutually agreed between trading partners, data elements may be concatenated into one bar code symbol to facilitate capture of more than one data element with a single scanning operation. Concatenation shall be in accordance to ANS MH10.8.2.

Two common techniques are used to concatenate data with bar code symbols. The first technique is the use of a combination of fixed length fields. The second technique employs a special concatenation character between variable length fields or, in some cases, between fixed and variable length fields. This International Standard recommends the use of the plus "+" character (ASCII Decimal 43) to delimit variable length fields when using Data Identifiers with either the Code 39 or Code 128 bar code symbologies. When using the GS1-128 bar code symbology, the function one (FNC1) character (transmitted as "GS" ASCII Decimal 29) shall be used to terminate variable length fields that are followed by another field.

4.5.2.2 2D symbol syntax

4.5.2.2.1 General

The encoding shall be as described in ISO/IEC 15434. When Data Identifiers are used, the first seven characters shall be "[)>$^{R}_{S}$06$^{G}_{S}$". When Application Identifiers are used, the first seven characters shall be "[)>$^{R}_{S}$05$^{G}_{S}$". For both Data Identifier and Application Identifier messages the last 2 characters, "$^{R}_{S}$$^{E}_{OT}$", are fixed (format trailer) for this application. When data elements are combined within a two-dimensional symbol, the "$^{G}_{S}$" (ASCII/ISO 646 Decimal "29", Hex "1D") character and the appropriate Data Identifier shall be used to identify each of the combined fields.

4.5.2.2.2 2D symbol syntax when using Data Identifiers

The example in Figure 1 is comprised of Data Identifiers, other overhead characters, and mandatory fields (an item identification, quantity, and a traceability identification [e.g. lot/batch number]. Thus, the character string (without blank spaces) is represented as follows:

[ ) > $^{R}_{S}$ 06 $^{G}_{S}$ 1P Item-Ident $^{G}_{S}$ Q Quant. $^{G}_{S}$ 1T Trace-Ident $^{R}_{S}$ $^{E}_{OT}$

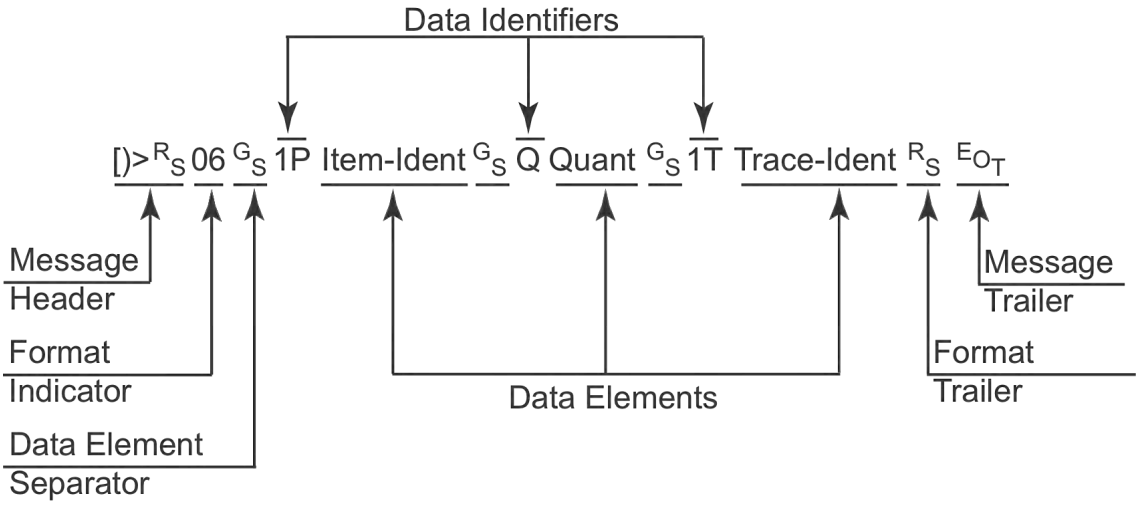


Figure 1 — Example of encoding Data Identifier data in a 2D symbol

4.5.2.2.3 2D symbol syntax when using Application Identifiers

The example in Figure 2 is comprised of Application Identifiers, other overhead characters, and mandatory fields (an item identification, quantity, and a traceability identification [e.g. lot/batch number]). Thus, the character string (without blank spaces) is represented as follows:

[ ) > RS 05 GS 01 Item-Ident GS 21 Trace-Ident GS 30 Quant. RS EOT

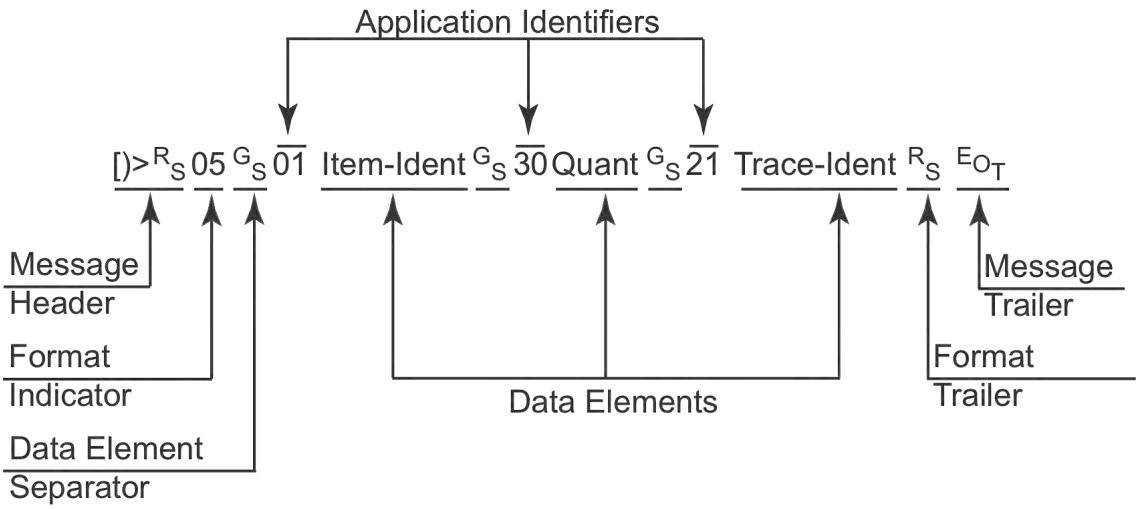


Figure 2 — Example of encoding Application Identifier data in a 2D symbol

4.5.2.3 General formatting for human-readable information

4.5.2.3.1 Common issues

Human-readable information can be human interpretation, human translation, data titles or free text and data.

Human-readable information within a single country should be in the national language of that country.

Products for export should have human-readable information in the language(s) mutually agreed upon between trading partners.

Regulations may require multiple languages on the product.

Choice of language is applicable to human translation, data area titles and free text.

4.5.2.3.2 Human-readable interpretation (HRI)

A human-readable interpretation (HRI) of each linear bar code symbol shall be provided adjacent to the bar code. Such human-readable interpretation shall represent the encoded data (see Figures 3 and 4).

The human-readable interpretation of the linear bar code symbol shall be printed above or below the bar code symbol.

For Data Identifier data, the human-readable interpretation shall represent the encoded data, exclusive of the Data Identifier. The Data Identifier appears in parentheses as part of the data area title, e.g. “(S) Serial #.”

When using Application Identifiers the AI appears in parentheses immediately preceding the human-readable interpretation.

For 2D symbols, human translation (see below) should be used.

4.5.2.3.3 Human translation

In addition to the human-readable interpretation, human translation of linear bar code information may be provided in a separate section of the label. See Figures 3 and 4.

Human translation of 2D symbols may be provided in a separate section of the label.

4.5.2.3.4 Data area titles

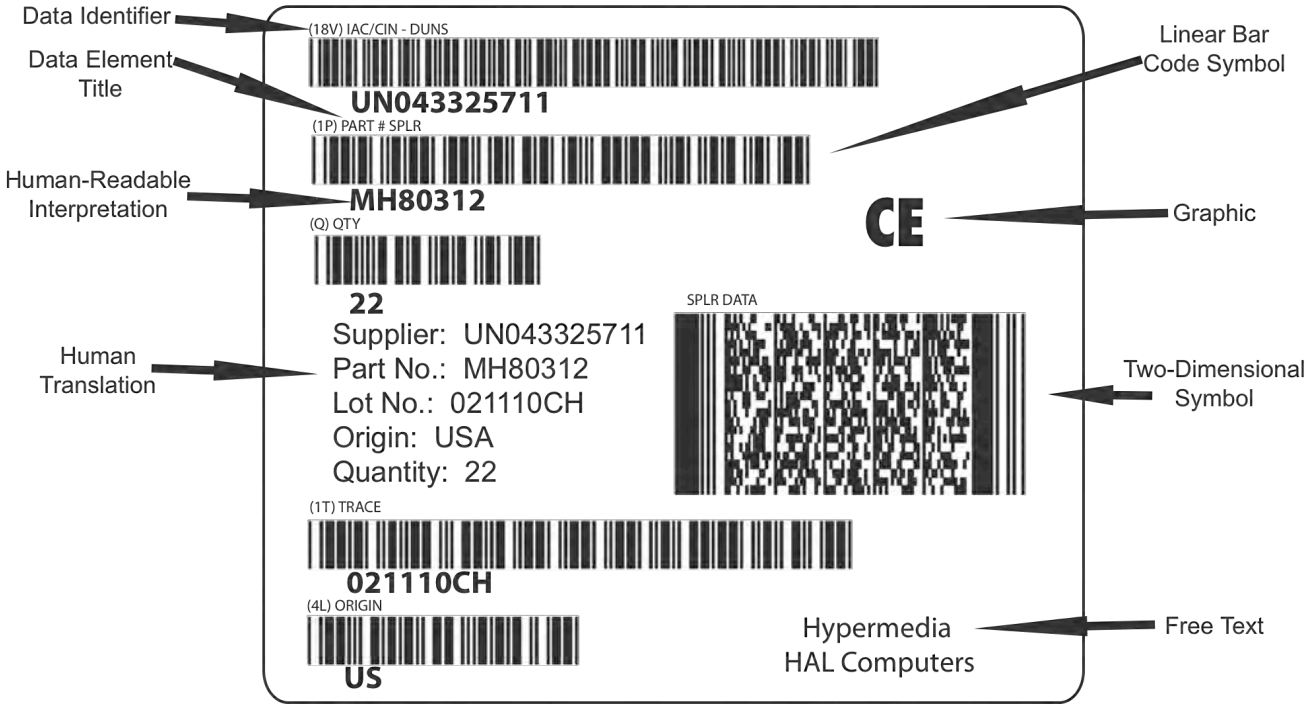
4.5.2.3.5 Linear symbols

Data areas comprise information in bar code or human-readable form. Data areas shall be identified with the corresponding data area title in human-readable text. A data area title is not required when a data area contains

- a single linear bar code symbol concatenating multiple data elements, or
- a data area containing multiple linear bar code symbols that are intended to be scanned in a single data capture operation.

Data area titles for linear bar code symbols may be presented with a full data element title, e.g. (S) Serial Number 123456, or an abbreviated data element title, e.g. (S) Ser. No. 123456. The data element title is placed directly after the Data Identifier.

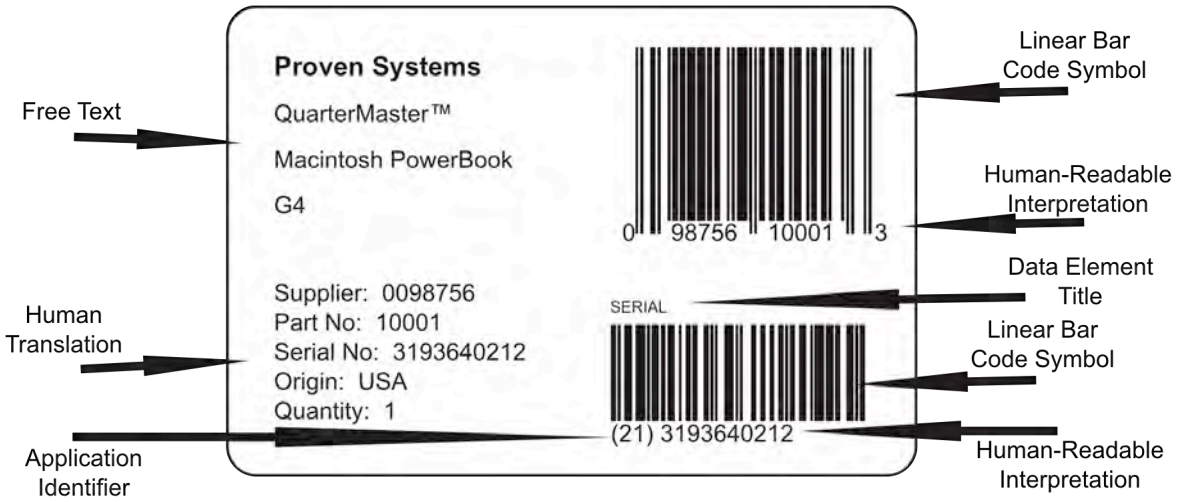
If the real estate available for marking is insufficient to support the marking of the data element title and the Data/Application Identifier, the data area title may be abbreviated to only include the Data/Application Identifier enclosed in parentheses [e.g. (S) 123456].



Key

1	Data Identifier	5	linear bar code symbol
2	data element title	6	graphic
3	human-readable interpretation	7	two-dimensional symbol
4	human translation	8	free text

Figure 3 — Examples of terminology for Data Identifiers (not to scale)



Key

1	free text	5	human-readable interpretation
2	human translation	6	data element title
3	Application Identifier	7	linear bar code symbol
4	linear bar code symbol	8	human-readable interpretation

Figure 4 — Examples of terminology for Application Identifiers (not to scale)

4.5.2.3.6 Two-dimensional symbols

When two-dimensional symbols are used each 2D symbol should be identified by the following data area titles, displayed above the 2D symbol:

A 2D symbol containing data meant for

- The supplier only shall be identified by the title ‘SPLR’,
- The customer only shall be identified with the title ‘CUST’,
- Both the supplier and the customer shall be identified with the title ‘SPLR/CUST’.

4.5.2.3.7 Free text and data

Human-readable information that is not a translation of the bar code information may be provided according to the requirements of the trading partners.

4.6 Data carriers

4.6.1 Data carrier selection

The choice of use of linear bar code, or 2D symbols, or both, as data carriers shall be agreed between trading partners.

4.6.2 General symbology requirements

Bar code and 2D symbologies used to meet the requirements of 4.6.4 shall be in accordance with the appropriate ISO/IEC JTC 1/SC 31 standard.

When implementing this International Standard, the reader output string should include the appropriate data carrier identifier as set forth in ISO/IEC 15424.

4.6.3 Linear symbols used on product packaging

The linear bar code symbologies permitted by this standard are

- Code 39 (reference: ISO/IEC 16388),
- Code 128 (reference: ISO/IEC 15417) for GS1-128 and Code 128 with Data Identifiers,
- Interleaved Two of Five (reference: ISO/IEC 16390) for ITF-14 symbols,
- EAN/UPC (reference: ISO/IEC 15420).

The specific linear symbology or symbologies to be used shall be mutually agreed upon between trading partners.

Recommended symbol parameters of the bar code symbols are shown in Tables 15 to 18. Deviations from the parameters recommended in this International Standard shall be mutually agreed between trading partners.

This International Standard recommends a minimum narrow element width of 0,17 mm. Regardless of the narrow element width; the linear symbol shall meet the minimum print quality requirements of 1,5/05/660 (± 10 nm), unless the symbol is direct printed on a kraft-coloured corrugated fiberboard substrate where the minimum print quality shall be 0.5/20/660 (±10 nm), or if the symbol is direct printed on a white top or full bleached corrugated fiberboard substrates where the minimum print quality shall be 1.5/20/660 (±10 nm). This restriction supersedes any “Minimum print quality” statements contained within Table 15.

The Code 39 wide to narrow ratio shall be within a range of 2,5:1 through 3,0:1. The inter-character gap for Code 39 shall be within the range of 1 to 3 times the narrow element width. The ITF-14 wide to narrow ratio shall be within a range of 2,5:1 through 3,0:1.

ITF-14 Symbols with X-dimensions at or below 0.635 mm (0.025 in) should not be printed directly on corrugated fiberboard with conventional (plate-based) processes. Packages and/or containers marked with ITF-14 Symbols with X-dimensions between 1,016 mm (0,040 in) and 1,219 mm (0,048 in) are acceptable based on historical specifications, but a migration to the 1,016 mm (0,040 in) maximum X-dimension should be made on new artwork. The ITF-14 symbol's bearer bar length ratio target is 2,5:1, and the acceptable range is 2,25:1 to 3:1.

For any appreciable degree of data security, the application in which the ITF-14 symbol is to be read should define a fixed length for the symbol (in this case 14 digits) and the symbol should employ bearer bars.

Table 15 — Product package label symbol grading requirements

Symbology	Data structure	Grade	Aperture	Wavelength
EAN/UPC	GTIN-8	1,5 (C)	6 mils	660 nm ±10 nm
EAN/UPC	GTIN-12	1,5 (C)	6 mils	660 nm ±10 nm
EAN/UPC	GTIN-13	1,5 (C)	6 mils	660 nm ±10 nm
GS1-128	GTIN-12, GTIN-13, GTIN-14	1,5 (C)	10 mils	660 nm ±10 nm
GS1-128	SSCC	1,5 (C)	10 mils	660 nm ±10 nm
ITF-14 (<0.635 mm X)	GTIN-12, GTIN-13, GTIN-14	1.5 (C)	10 mils	660 nm ±10 nm
ITF-14 (≥0.635 mm X)	GTIN-12, GTIN-13, GTIN-14	0,5 (C)	20 mils	660 nm ±10 nm
Code 128	Using Data Identifiers	1,5 (C)	5 mils	660 nm ±10 nm
Code 39	Using Data Identifiers	1,5 (C)	5 mils	660 nm ±10 nm

Table 16 — Product package label symbol dimensions (intended for hand scanning)[2]

Symbol	X-Dimension (mm)			Minimum Symbol Height for Given X (mm)			Quiet Zone	
	Minimum	Target	Maximum	For Minimum X-Dimension	For Target X-Dimension	For Maximum X-Dimension	Left	Right
EAN-13	0,264	0,33	0,66	20,73	25,91	51,82	11X	7X
EAN-8	0,264	0,33	0,66	17,03	21,29	42,58	7X	7X
UPC-A	0,264	0,33	0,66	20,73	25,91	51,82	9X	9X
UPC-E	0,264	0,33	0,66	20,73	25,91	51,82	9X	7X
ITF-14	0,250	0,33	0,495	12,70	12,70	12,70	10X	10X
GS1-128	0,250	0,33	0,495	12,70	12,70	12,70	10X	10X
Code 128	0,250	0,33	0,66	5,00	5,00	5,00	10X	10X
Code 39[3]	0,250	0,33	0,66	5,00	5,00	5,00	10X	10X

[2] If one is unsure of whether the intended use is for hand scanning or unattended scanning, the dimensions used should be those for unattended scanning

[3] Narrow element width definition is to satisfy the needs of laser based and imager based scanning. While the minimum is recommended for open systems, agreement between trading partners can specify a narrower element width.

Table 17 — Product package label symbol dimensions (intended for unattended scanning)[4]

Symbol	X-Dimension (mm)			Minimum Symbol Height for Given X (mm)			Quiet Zone	
	Minimum	Target	Maximum	For Minimum X-Dimension	For Target X-Dimension	For Maximum X-Dimension	Left	Right
EAN-13	0,495	0,66	0,66	38,87	51,82	51,82	11X	7X
EAN-8	0,495	0,66	0,66	31,94	42,58	42,58	7X	7X
UPC-A	0,495	0,66	0,66	38,87	51,82	51,82	9X	9X
UPC-E	0,495	0,66	0,66	38,87	51,82	51,82	9X	7X
ITF-14	0,495	0,495	1,016	32,00	32,00	32,00	10X	10X
GS1-128	0,495	0,495	1,016	32,00	32,00	32,00	10X	10X
Code 128[5]	0,495	0,495	1,016	32,00	32,00	32,00	10X	10X
Code 39[5]	0,495	0,495	1,016	32,00	32,00	32,00	10X	10X

Table 18 — EAN/UPC dimensions

Magnification factor	Module width (nominal) mm	EAN-13/UPC-A dimensions mm		EAN-8 dimensions mm	
		Width	Height	Width	Height
0,80	0,264	29,83	20,73	21,38	17,05
0,85	0,281	31,70	22,02	22,72	18,11
0,90	0,297	33,56	23,32	24,06	19,18
0,95	0,313	35,43	24,61	25,39	20,24
1,00	0,330	37,29	25,91	26,73	21,31
1,05	0,346	39,15	27,21	28,07	22,38
1,10	0,363	41,02	28,50	29,40	23,44
1,15	0,379	42,88	29,80	30,74	24,51
1,20	0,396	44,75	31,09	32,08	25,57
1,25	0,412	46,61	32,39	33,41	26,64
1,30	0,429	48,48	33,68	34,75	27,70
1,35	0,445	50,34	34,98	36,09	28,77
1,40	0,462	52,21	36,27	37,42	29,83
1,45	0,478	54,07	37,57	38,76	30,90
1,50	0,495	55,94	38,87	40,10	31,97
1,55	0,511	57,80	40,16	41,43	33,03
1,60	0,528	59,66	41,46	42,77	34,10
1,65	0,544	61,53	42,75	44,10	35,16
1,70	0,561	63,39	44,05	45,44	36,23
1,75	0,577	65,26	45,34	46,78	37,29
1,80	0,594	67,12	46,64	48,11	38,36
1,85	0,610	68,99	47,93	49,45	39,42
1,90	0,627	70,85	49,23	50,79	40,49
1,95	0,643	72,72	50,52	52,12	41,55
2,00	0,660	74,58	51,82	53,46	42,62

Note: EAN/UPC symbols for direct printing on corrugated fiberboard should not be printed with a Magnification Factor less than 190%.

[4] If one is unsure of whether the intended use is for hand scanning or unattended scanning, the dimensions used should be those for unattended scanning

[5] Code 128 and Code 39 symbols with X-dimensions below 0.635 mm should not be printed directly on corrugated fibreboard.

Two-dimensional (2D) symbols used on product packages

4.6.3.1 General

The two-dimensional symbologies permitted by this International Standard are

— PDF417 (reference: ISO/IEC 15438),

— Data Matrix ECC 200 (reference: ISO/IEC 16022), and

— QR Code (reference: ISO/IEC 18004).

Within this International Standard, linear bar code symbols serve as the default symbology. The use of two-dimensional symbols and the specific two-dimensional symbol to be used shall be mutually agreed upon between trading partners. Users should ensure that the scanning technology they select is capable of reading the symbols they choose to read.

Either 2D-capable imaging or 2D-capable laser scanning technologies can read both linear bar code symbols and the PDF417 symbology. Data Matrix ECC 200 and QR Code require 2D-capable image scanning technology.

4.6.3.2 "X" dimension

The minimum narrow element dimension "X" for the PDF417, Data Matrix ECC 200, and QR Code symbologies shall be 0,254 mm. The recommended "X" dimensions for each symbology are

— 0,254 mm for PDF417,

— 0,38 mm (cell size) for data matrix ECC 200, and

— 0,38 mm (cell size) for QR Code.

The "X" dimension shall be determined by the printing capability of the supplier/printer of the label.

4.6.3.3 Print quality

Print quality shall be tested in accordance with ISO/IEC 15438 for the PDF417 symbology, ISO/IEC 16022 for the Data Matrix symbology, and ISO/IEC 18004 for the QR Code symbology. For the product packaging application, the minimum symbol grade should be 1,5 / 5 / 660 (± 10 nm), where

— Recommended print quality grade, on 2,5 (B) at the point of printing the symbol,

— Measurement aperture = 0,125 mm (0,005 in), and

— Light source wavelength = 660 nm ± 10 nm.

4.6.3.4 Error correction level

The PDF417 symbol error correction level depends on the number of data codewords. A minimum error correction level of 3 is recommended.

There are two types of Data Matrix symbologies: ECC 000-140 with several available levels of convolutional error correction, and ECC 200, which uses Reed-Solomon error correction. Within this International Standard, only ECC 200 is recommended. Data Matrix ECC 200 uses the automatic error correction as specified in ISO/IEC 16022.

QR Code shall use error correction level "M" as specified in ISO/IEC 18004.

4.6.3.5 Syntax and semantic recommendations

Symbols compliant to this International Standard should use the semantics specified in ISO/IEC 15418 and the syntax specified in ISO/IEC 15434.

4.6.4 Data carrier/Symbology identifiers

Product package applications that require a distinction between different symbologies/data carriers and options within a symbology/data carrier should use the methods specified in ISO/IEC 15424.

4.7 Label size and layout

4.7.1 Label size

The dimension of the label should suit the dimensions of the package and may be dependent on the space needed for the required information.

4.7.2 Label layout

Label layout refers to the positioning of the fields on a label. Layout of linear bar code or two-dimensional symbols will depend on the available space on a label, packaging techniques and other factors.

When multiple bar code symbols or two-dimensional symbols are to be placed in line or in contiguous fields, care must be taken to avoid layouts that inhibit scanning the individual data elements. The layout of the label should be designed to accommodate the package size and should facilitate scanning of the bar codes.

Examples of label layouts for patterns are shown in following Figures.

4.7.3 Examples of label layout

4.7.3.1 See Figures 5 and 6 for examples of labels with linear bar codes and human-readable information.

Figure 5 — Examples of bar code and HRI for GS1
(not to scale)

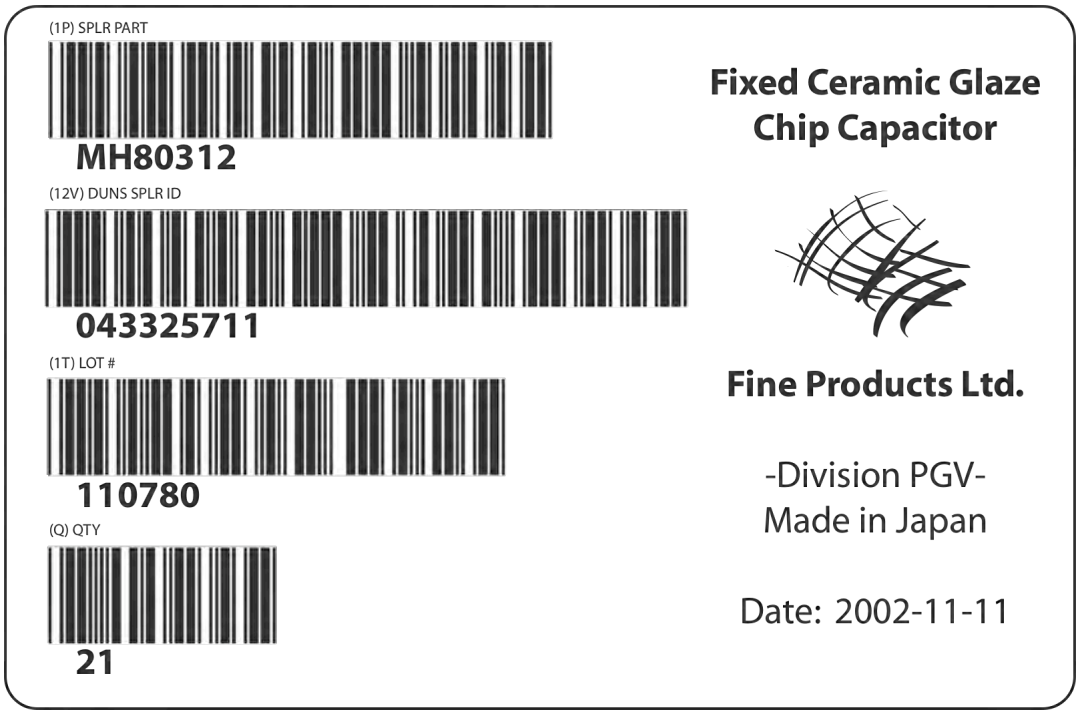


Figure 6 — Examples of Code 39 bar code and HRI for Data Identifiers (not to scale)

4.7.3.2 See Figures 7, 8 and 9 for examples of labels with 2D symbols and human-readable information.

Figure 7 — Example of PDF417 with DIs (not to scale)

Figure 8 — Example of data matrix with DIs
(not to scale)

Figure 9 — Example of QR Code with DIs
(not to scale)

4.7.3.3 See Figure 10 for an example of a label with linear bar codes, 2D symbol, and human-readable information.

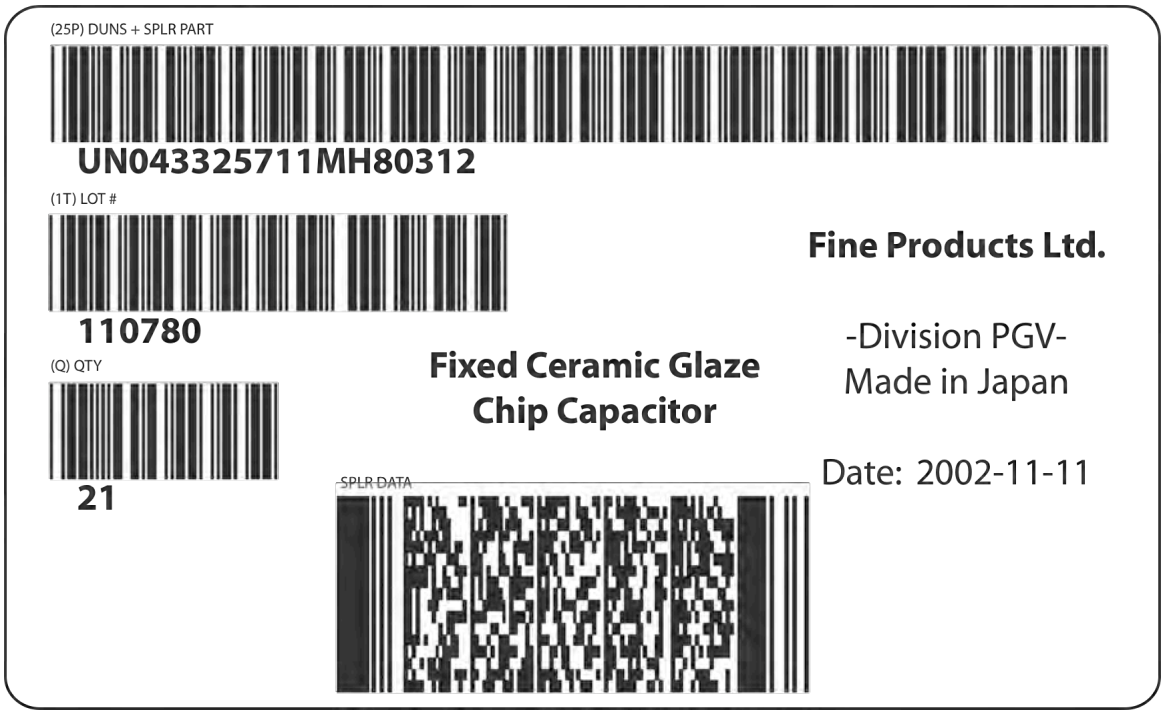


Figure 10 — Example of linear bar code symbols and PDF417 with DIs

4.7.4 Label location

Label location refers to the positioning of the label on the package. Each label should be located in a position that facilitates scanning. Various examples are shown in Figures 11 to 16.

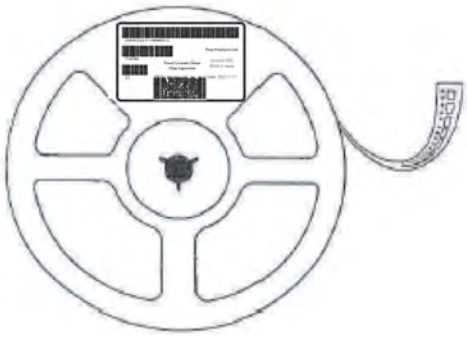


Figure 11 — Tape-and-reel reel
(not to scale)

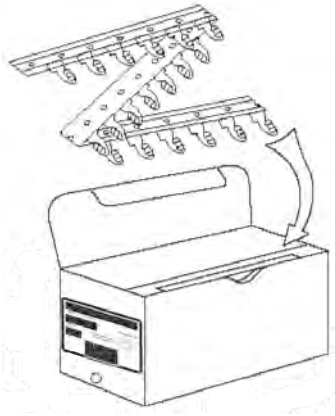


Figure 12 — Ammo box
(not to scale)

Figure 13 — Bag
(not to scale)

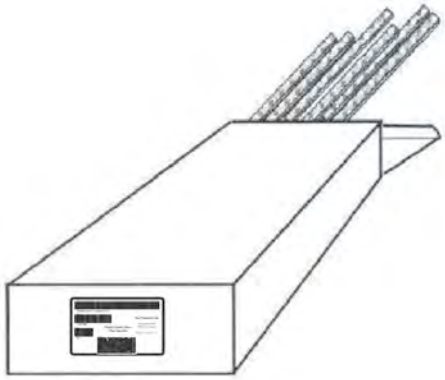


Figure 14 — Box of tubes (not to scale)
(Tubes are multiple components)

Figure 15 — Box
(not to scale)

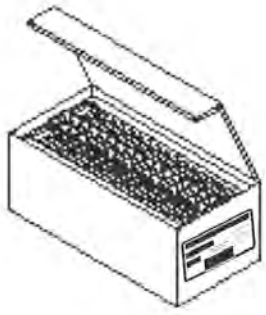


Figure 16 — Box of components
(not to scale)

Annex A
(normative)

Direct contact printing of linear bar code symbols on corrugated fiberboard [6]

A.1 Scope

This Annex is intended to provide information on the direct contact printing of linear bar code symbols on corrugated fiberboard using printing equipment commonly available in the corrugated industry.

Typical symbologies direct printed on corrugated fiberboard include the following:

- Interleaved Two of Five (ITF, ITF-14)
    - Most frequently printed as ITF-14 and otherwise known as the “Corrugated Case Code,” “the Shipping Container Symbol”, or the “Warehouse Code”
    - This symbology may also be used by customers in a shortened form for their own internal distribution needs
- UPC-A and EAN-13. These are the 12 and 13 character versions of the retail check-out code
- Code-128 (GS1-128)
- Code 39 (also known as Code 3 of 9)

Sophisticated multi-colour corrugated fiberboard printing presses and pre-print liner presses have the capability to hold tighter dimensional tolerances when compared to conventional 2 and 3 colour, corrugated fiberboard printing equipment. These more sophisticated printing presses, upon completion of successful trials, may be able to print smaller magnification factors of various bar codes than referenced in this document. The key requirement is trial and error to understand a given piece of printing equipment’s dimensional limitations. However, the notations on Print Contrast (Symbol Contrast) are applicable for all types of corrugated fiberboard printing equipment from older 2-colour presses to new multi-colour pre-print presses.

Comments on ink jet printing on corrugated boxes are also included.

A.2 Safety precautions

If paper knives or cutting tools are used in sample preparation, appropriate care must be taken to prevent knife cuts. If verification devices have a laser light source, care must be taken to insure the light source is never directed at the human eye.

A.3 Printing plates

NOTE 1: Comments on printing plates are applicable to photopolymer and laser engraved rubber. For best results, moulded rubber printing plates, even if available, should not be used for printing bar codes on corrugated fiberboard.

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6 This normative guidance was originally created by the Fibre Box Association, 2850 Golf Road, Suite 412, Rolling Meadows, IL 60008, (V): +1 847/364-9600, (U): http://www.fibrebox.org/

— Bar code printing plates should be purchased such that the width of bars in the printing plate are delivered to the corrugated fiberboard printer at a finished X bar dimension at the bottom range of the tolerance of the symbology, and magnification factor of that symbology, being printed. (See Note 2 below). The finished bar width is to be the dimension specified by the printer at -0,000/+0,025 mm

NOTE 2: This practice is necessary because direct contact printed bar code symbols “print” wider than the actual width of the bars in the printing plate due to ink absorption (wicking) as well as distortion caused by the pressure of the impression cylinder against the substrate. The difference between the nominal bar dimension and the specified bar width for printing plates is called Bar Width Reduction (BWR). Both wide and narrow bars have the same BWR. In addition, the bar code’s “spaces” in the printing plate are correspondingly wider than nominal by the same BWR dimension that is used to narrow the bars. The net result is that the overall symbol length of both the printing plate and the printed symbol meets the nominal dimension specified for the symbol. Ordering printing plates in the above described manner gives the printer nearly the entire tolerance of the symbol being printed to accommodate “print gain” (the growth in dimension between the actual bar width on the printing plate and the finished printed bar dimension) while still being dimensionally “in spec”.

Example: 100% magnification, Interleaved 2 of 5 (ITF) Symbol. The narrow bar dimension specification is 1,016 mm ± 0,305 mm. Therefore, the narrow bars on the finished photopolymer printing plate should be 0,711 mm -0,000/+0,025 mm.

NOTE 3: Another reason for ordering printing plates with bars at the full minus of the tolerance is that scanners tend to “read” bar codes with narrow bars more easily than they “read” bars that are “fat” (printed on the “wide” side of the tolerance).

NOTE 4: General printing plate wear should not affect bar width significantly. Any slight wear of the bar edges should be compensated for by the angle built into the relief of the printing plates.

— Bar code printing plates for direct contact printing the ITF Symbol on corrugated substrates must have a bearer bar that completely surrounds the bar code symbol and its “quiet zone.” (Ref. GS1 General Specification Ver. 9). While specifications for other bar codes do not require bearer bars, the use of bearer bars for direct contact printing of all types of bar codes is very strongly recommended in order to produce the best results.

NOTE 5: The nominal specified minimum dimension of the Quiet Zone for most symbologies is 10 times (10x) the nominal narrow bar dimensions for the symbol size and magnification factor being printed. There have been several instances of Quiet Zone failure based on squeeze out of the Bearer Bar. It is strongly recommended that corrugated printers specify a minimum Quiet Zone of 12 times (12x) the nominal narrow bar of the symbol being printed.

— It is the responsibility of the corrugated printer to specify to the printing plate maker whether or not the bar code is printed in the picket fence (bars parallel to the printing press direction) or stepladder (bars perpendicular to the printing press direction) configuration. The printing plate maker has the responsibility to manufacture the bar code printing plate to the corrugated printer’s specifications, taking into account any known accommodation for a “stretch factor” for the stepladder configuration.

— Because some corrugated customers supply printing plates to corrugated plants, plants receiving customer-supplied printing plates should communicate a clear understanding of the corrugated printer’s specifications (requirements) for bar code printing plates to their customers and in some instances their customers’ customers. Minimum sizes of the various codes that the corrugated printer will print and the finished printing plate bar dimensions specified for typical magnification factors of these bar codes should be included in such communication.

— The plate maker should always supply a “proof” of the bar code printing plate. The proof is useful to check off the human-readable characters. The customer should also sign off on the proof, affirming that the human-readable characters are those that are intended and which match the product being packaged.

— The finished bar code printing plate should be within ±0,050 mm of the calliper (height) of the other printing plates in the mount (prior to mounting).

— Durometer of printing plates today is typically between 30 and 40 (Shore A units) and this range of durometer values has proven to work well on most substrates for direct contact printing bar codes on corrugated.

— It is always helpful to work with printing plate and ink suppliers if questions or problems arise with regard to successful bar code printing.

— With the use of liquid or sheet photopolymer printing plates, most issues with regard to ink acceptance, ink release, and substrate acceptance have worked themselves out. Should box plants have problems with ink transfer (insufficient. excess. or "wicking"), box makers, in addition to consulting with their ink and printing plate suppliers, should involve their liner supplier(s). It is possible that a high hold out substrate, common in some full bleached or highly sized liners, or very water absorbent liners, possible if sizing is insufficient, could be the root cause of the problem.

— Film master procurement, when required, is the responsibility of the printing plate supplier.

— Today, many bar code images are produced on a computer and are transmitted directly to the printing plate making machinery. Whether a film master or a direct computer generated image is used, the responsibility of the printing plate maker is to produce the finished printing plate to the specifications of the corrugated printer as noted in the initial bullets of this section. The film master, when used, is part of the printing plate manufacturer's process, not the box maker's process.

A.4 Printing plates - areas of disagreement

There remain many areas of disagreement among corrugated printers regarding printing plate practices for Bar Code printing.

— Most corrugated printers do not mix photopolymer and rubber plates on the same mount, although some do without any apparent degradation in bar code quality.

— Most corrugated printers do not incorporate any new bar code printing plates into an existing mounted set of previously used printing plates (slugging). However, some corrugated printers use the mounter-proofer to build up the older plates so that all plates in the finished mount are at nominal ±0,127 mm.

— An alternative to slugging for one-colour jobs (or where the total number of colours required is one less than the number of colours on the printing press) is to print the bar code on an unused printing station. Essentially, this turns a one-colour job into a two-colour job, even if both colours are the same.

— Many corrugated printers advocate the use of thin printing plates plus the use of a compressible backing. The theory is that the compressible backing will provide some "give" as the printing plates make contact with the substrate, thereby minimizing bar width growth due to squeeze or deformation of the printing plate material during the printing process.

— Other printers have experimented with thin printing plates mounted on a solid built-up backing to meet the overall plate thickness specification of the printing press cylinders. The theory here is that the reduced amount of material in thin plates will deform less than conventional height plates under operating conditions.

— Yet many corrugated printers produce excellent bar codes with traditional 6,350 mm calliper printing plates with no special backing.

— Many corrugated printers believe that bar code quality deteriorates when symbology printing is done with the bars perpendicular to the press direction (stepladder configuration) or when the bars are printed perpendicular to the corrugated flute direction. In the former situation "stretch" is not perfectly controllable. In the latter situation, if the substrate has any "washboarding" (a controllable corrugator problem, not a printing problem) the bars may print wider at the crossing of each flute.

— Given the divergent viewpoints of corrugated printers on the subject of printing plates, it is not surprising that different plants develop different, yet successful, procedures with regard to printing bar codes. The recommendation with regard to printing plate practices is for each plant to document its successful practices and operate in accordance with those practices, even if extra expenditures for printing plates are necessary.

— Where customer involvement is required because customers provide printing plates, the documented practices should be shared with those customers so that printing plates meeting the plant's specifications can be provided. When customers supply common printing plates to more than one corrugated supplier, a slightly different bar code printing plate may have to be supplied to each corrugated supplier for the same final print job.

A.5 Ink

— Users must specify and printers must use a colour in combination with a substrate that will meet the Symbol Contrast requirements of the symbology being printed.

Example: The colours shown below (Ref: Flexo Colour Guide for Printing Inks on Corrugated, Edition IX published by the Glass Packaging Institute), when printed using good quality ink, and when combined with the nominal reflectance range of natural kraft coloured substrates, have been shown to be able to meet an ISO/ANSI "D" (0,5/20/660) minimum grade for Symbol Contrast when printing the ITF-14 symbology.

Best
GCMI 90 Black
GCMI 30 Blue
GCMI 33 Blue
GCMI 39 Blue
GCMI 3086 Blue

Fair
GCMI 38 Blue
GCMI 387 Blue
GCMI 3213 Aqua
GCMI 2008 Green
GCMI 523 Brown

Good
GCMI 31 Blue
GCMI 32 Blue
GCMI 34 Blue
GCMI 300 Blue
GCMI 394 Blue
GCMI 20 Green
GCMI 21 Green
GCMI 24 Green
GCMI 25 Green

Marginal (Trial with customer before using)
GCMI 3229 Blue
GCMI 29 Green
GCMI 52 Brown

For White Top and full bleached substrates, a wider range of colours may be used. It is recommended that box plants go through a trial process to confirm that a given colour will meet the ISO/ANSI Symbol Contrast requirements for the symbol being printed.

Many symbologies require an ISO/ANSI "C" [1,5/6 or 10 (depending on the Symbology)/660] grade as a passing grade. Symbols requiring an ISO/ANSI "C" as a passing grade cannot be printed on natural kraft coloured liners and still meet the "C" grade requirement as the Symbol Contrast grade will typically be a "D". See an additional discussion of this topic in the "ISO/ANSI Grades" section of this document.

A.6 Production practices

A.6.1 Machine conditions

— All rolls - concentric (TIR) within 0,050 mm.

— All rolls - parallel within 0,050 mm.

— The combination of TIR and out-of-parallel between any pair of adjacent rolls - within 0,076 mm.

— All nip point adjustments (set by the operator) in good working condition.

— All components in the machine clean and free of any ink residue or other foreign material.

A.6.2 Operating practices

A.6.2.1 Printing plate mounting:

— The preferred method is to mount printing plates “in the curve” using a “Mounter Proofer.”

— Absolutely never alter the human-readable characters of the bar code symbol or separate those characters from the main part of the bar code printing plate.

— Printing plates should be mounted on a carrier sheet at the locations and to the dimensional accuracy specified by the customer.

— Once a bar code printing plate is mounted on a carrier sheet, it should be left intact. Removing and remounting negatively affects quality and accuracy of bar code printing.

— All printing plates mounted on the carrier sheet (bar code plates and other plates) are to be mounted to the press’s printing cylinders specified total height (thickness) with a tolerance of ± 0,127 mm.

A.6.2.2 Ink:

— Ink running viscosity and pH must be maintained to meet conditions of the substrate without smearing or fading of the colour of the printed graphics.

A.6.2.3 Operating variables:

— The durometer of the printing plates, the anilox roll cell screen, the ink volume capacity of the anilox roll, and the wiper roll durometer all contribute to variation in the printing process, and must be synchronized to provide the best quality printing.

— Printing impression must be adjusted carefully to avoid slippage, insufficient ink application (from insufficient impression), or excess bar width growth and haloing (from too much printing plate impression or excess anilox roll to printing plate pressure).

— Adjustment of the “anilox roll to the printing plate” pressure must be made to ensure proper ink application to the printing plates. Too light = no ink. Too much = burning up plates, causing surface degradation of the printing plates. Excess anilox roll to printing plate pressure can also lead to ink build-up on the printing plate edges, resulting in a condition similar to “haloing”.

— The wiper blade or wiper roll must be adjusted properly to the anilox roll to allow for proper ink film to be transferred to the printing plates.

— Paper dust (from corrugated board surfaces, the slitting and slotting process, and ink “picking”) can accumulate on the printing plates. Operators must observe these conditions and control paper dust accumulation by periodically stopping the printing press and washing the printing plates. Proper maintenance and use of the ink filter also helps remove paper dust from the system.

— Corrugated board variables to be minimized
  - Calliper variation
  - Washboarding
  - Changes in linerboard (substrate) characteristics:
    - Porosity
    - Paper finish

- Wettability

NOTE 6: The three linerboard characteristics listed are not typically controllable at a box plant and call into use the skill of the operator to maintain bar code (and other graphics) quality.

A.7 Quality control

NOTE 7: Note: "Verification" differs from "Scannability."

"Scannability" is the determination as to whether or not a bar code will "read". "Verification" is the determination as to whether or not a bar code is within specification. Scanners used in industrial warehouse applications and at retail checkouts have advanced in technology since the early 1970s when the initial bar code specifications were written. Today, scanners are forgiving and can "read" bar codes that are "out-of-specification". As printers we must meet a higher standard than just "Scannability". "Verification" to specification is the only correct methodology to ensure that we, as printers, are producing bar codes that work reliably in the marketplace.

A.7.1 Equipment:

A portable hand held verifier is required that is capable of verifying bar codes to all ISO/ANSI parameters and to traditional standards. The ability to determine substrate reflectance is highly desirable. The verifier should be ordered with a compatible printer so the verification of results can be saved for customer acknowledgement and/or file reference. At a minimum, the verifier must be capable of verifying the following bar codes:

— Interleaved Two of Five (ITF, ITF-14) (Formerly known as the Shipping Container Code, the Warehouse Code, or the Corrugated Case Code)

— UPC-A & EAN-13. These are the 12 and 13 character versions of the retail checkout code.

— Code-128 (GS1-128)

— Code 39 (also known as Code 3 of 9)

The verifier must be equipped with 3 light source apertures to accommodate the specifications for verification of the different codes as follows:

Table 1 — Verifier apertures and uses

Aperture	Used for Codes
20 Mil	Most sizes of the ITF-14 Code (≥62,5% size) and the larger sizes of Code 39 [≥0,64 mm narrow bar]
10 Mil	Code-128 and the smallest sizes of the ITF-14 Code (<62,5% size) and the smaller sizes of Code 39 [≥0,64 mm narrow bar]
6 Mil	All sizes of the UPC-A & EAN-13 Code (Retail Check-out)
5 Mil	All sizes of Code 39 and Code 128 printed on label stock

Aperture changes may be built-in or accomplished via changes in optics. The verifier must have a light source of 660 ± 10 nanometres (nm). This is the light source specified for most of the codes we print. All verifiers should have the capability of being programmed to provide the average of up through 10 readings of a given code.

NOTE 8: Hand held laser "gun-type" verifiers are not acceptable for ISO/ANSI verification. These instruments are only capable of verifying 3 of the 8 or 9 (depending on the verifier manufacturer) ISO/ANSI parameters and Symbol Contrast is not among the 3 parameters that the gun-type verifiers can verify.

A.7.2 Calibration: Follow verifier manufacturer's recommendations.

A.7.2.1 Procedure:

Follow the manufacturer's instructions regarding setting up the verifier for light source, aperture, programming, wand or "shoe" movement, and use of your printer.

The official ISO/ANSI verification methodology is to take 10 readings starting at 10% (dimensionally) down from the top of the bar code symbol and take additional readings at equal intervals, finishing up at 90% down from the top. This area is referred to as the Inspection Band. ISO/ANSI verification typically analyzes 8 parameters (Symbol Contrast, Defects, Decodability, Modulation, Reference Decode, Refl (Min)/Refl (Max), Edge Contrast (Min), and Application Compliance. Some verifiers add a 9th ISO/ANSI parameter, the "Quiet Zone." Other verifiers include Quiet Zone non-conformities with the "Defects" parameter. When doing multiple scans of the same symbol, the averages shown on the "average" print out are averages of the individual parameters.

All of the scans taken on the symbol are used to calculate the final ISO/ANSI grade - referred to as the Overall Symbol Grade. Each time the symbol is scanned, an Overall Grade is calculated for that individual scan by using the lowest grade of all the individual parameters described above. For example, if the lowest parameter grade on the specific scan is calculated to be a "C" level, then the Overall Grade for that scan is given a "C".

The Overall Symbol Grade for the symbol is calculated by averaging the individual Overall Grades for each of the scans taken on the symbol. The numeric form of the grades is used to calculate the Overall Symbol Grade. Values of the letter grades are; A=4, B=3, C=2, D=1, F=0.

Below is an example of how an Overall Symbol Grade is calculated from 10 individual scans on the symbol;

- Scan 1 Overall Grade=B (3)
- Scan 2 Overall Grade=B (3)
- Scan 3 Overall Grade=C (2)
- Scan 4 Overall Grade=C (2)
- Scan 5 Overall Grade=A (4)
- Scan 6 Overall Grade=B (3)
- Scan 7 Overall Grade=C (2)
- Scan 8 Overall Grade=B (3)
- Scan 9 Overall Grade=D (1)
- Scan 10 Overall Grade=C (2)

Overall Symbol Grade = (3+3+2+2+4+3+2+3+1+2)/10 = 2.5 (B)

The Overall Symbol Grade must be displayed using the aperture and wavelength used in the calculation.

For example if a 10 mil aperture and 660 nm wavelength of light (red) was used in the scans above, the grade must be reported as 2,5/10/660. Verifiers additionally indicate the letter-form of the grade in various ways. Two examples are 2,5 (B)/10/660 and B/10/660.

NOTE 9: For a discussion of each of the individual ISO/ANSI parameters, consult the owners/operators manual for your verifier.

Plants typically don't follow the 10-scan ISO/ANSI protocol for normal verifying activities. The following are 3 plans to handle normal plant verification activities.

1. For bar code customers who place moderate demands on the plant for bar code verification:

   — Perform a single-pass verification on one of the first "good production" boxes from the run.

   — Perform an additional single pass verification every 3500-4000 impressions.

   — The off bearer/unit builder is to look at the bar codes for dirty plates, excess impression, etc. at least once every 500 boxes (typical unit size). A surprisingly high number of bar code nonconformities, even dimensional tolerance issues, can be found in bar code printing through visual methods alone.

   — Whenever a "failing" grade (F) is observed or when visual inspection suggests, stop the press and correct the problem (wash the printing plates, reduce the printing plate impression, etc.).

   — Print out one or two successful verification scans. Retain one attached to the Production Card in the Customer Service files and send the second, if required, to the customer.

2. For customers who have never indicated any interest as to whether or not bar codes are verified, follow the same set of single pass scans and visual observations as above, but it is the plant's option to print out a verification scan and attach it to the Production Card.

3. For customers demanding a high level of verification, perform the same set of single scan analysis as in Plan 1. However, in addition to the normal verifications, pull 10 random finished boxes to verify off-line. Do a 3-pass average for each bar code on each box. Report the "average" result on a form stating the final grade for each symbol on that box. Complete in the same manner for the remaining 9 boxes and record on the form. For any bar code yielding an "F" grade on the 3-pass average, re-verify that bar code using the official 10-pass ISO/ANSI method. As with plan one, corrective action should be taken whenever "F" grades are found. Retain the report form in the plant's files and share data with customers as required.

NOTE 10: For all plans, all bar codes on a given sample box should be included in your evaluation.

NOTE 11: Certain customers may require additional verification. These suggested plans do not restrict plants from putting together unique procedures for bar code verification frequency and reporting or from complying with customer-mandated verification plans.

NOTE 12: Poor verifier technique can result in poor grades that do not reflect the true print quality of a symbol. An operator should practice on known symbols to develop a good technique. It is nearly impossible to generate an ISO/ANSI grade that is better than the actual symbol print quality but it is easy to generate one that is worse. Therefore, if there is a question, the better grade is generally the true grade.

Table 2 — Typical passing grades

Code		Passing Grade
ITF-14 [≥0,64 mm narrow bar:	≥ 62,5% Size]	"D" (0,5)
ITF-14 [< 0,64mm narrow bar:	< 6,25% Size]	"C" (1,5)
UPC-A & EAN-13	All Sizes	"C" (1,5)
Code-128	All Sizes	"C" (1,5)
Code 39		*

* The most frequent passing grade for Code 39 direct printed on corrugated for the sizes we print [narrow bars ≥ 0,64mm] will be a "D". Different industries that use Code 39 may have their own passing grade criteria. Plants should question their customers about passing grades when printing Code 39.

A.7.2.2 ISO/ANSI grades

— The ISO/ANSI Symbol Contrast parameter is based on the reflectance difference between the printed bars and the unprinted substrate. The other ISO/ANSI parameters, Reference Decode, Decodability, Edge Contrast, Modulation, Defects, Reflectance Min ÷ Reflectance Max and Quiet Zone (if not included in the "Defects" parameter as some verifier manufacturers do) are based on reflectance contrast and the duration of the reflectance contrast. This basis for ISO/ANSI verification reinforces the need for dimensionally accurate (within tolerance) printed bars with clean, sharp edges.

— As specified in the UCC/EAN General Specification, the minimum acceptable ISO/ANSI symbol grade is a "D" (0,5) for the ITF Symbol when the specified light source (660 nm) and aperture (20 mil – 0,51 mm) is used. For symbols printed on natural kraft-coloured substrates, the "Symbol Contrast" characteristic will usually be the controlling factor, as the Symbol Contrast verification result will be a D most of the time. The remaining ISO/ANSI characteristics will normally grade out as A, B, or C. For symbols printed on white top (mottled white) or full bleach substrates, all of the ISO/ANSI characteristics will normally grade out as A's, B's or C's. (See following bullet point.)

— Other symbologies [UPC-A & EAN-13 (the retail check-out symbols) and Code 128] have minimum ISO/ANSI grade requirements of "C" (1,5) and printing these symbologies on natural kraft will result in an unacceptable grade due to the Symbol Contrast and aperture size problems noted below. Possible solutions for unacceptable Symbol Contrast results include the use of white top (70% substrate reflectance) or full bleached (80% substrate reflectance) substrates or printing a white block first with the bar code printed on top of the white block.

NOTE 13: The D grade (.5) for Symbol Contrast (when printed on natural kraft) results from the normal range of reflectance of natural kraft-coloured substrates, which is from 28% to 52% (averaging about 40%). The combination of this range of substrate reflectance and the reflectance values for bars printed with the acceptable ink colours, yields a range of net reflectance values that will result in a D (0,5) grade for Symbol Contrast.

— The 195% - 200% UPC-A & EAN-13 codes and the largest sizes of Code 128 [narrow bars ≥0,64 mm)] are of a size that technically should be scanned using a 20 mil (0,51 mm) aperture if the scanning environment were not specified. However, GS1 specifies the use of a 6 mil (0,15 mm) aperture for all sizes of the UPC-A and EAN-13 symbols, correlating with the tabletop type of scanners generally used in the retail environment. The use of a 10 mil (0,25 mm) aperture is specified by GS1 to verify all sizes of the Code-128 symbol (Ref. the GS1 General Specification). Aperture size has a direct affect on evaluating the ISO/ANSI Defect characteristic. A 10 mil (0,25 mm), and, particularly, a 6 mil (0,15 mm) aperture, will register Defects (for instance small voids in the printing) far more easily than the 20 mil (0,51 mm) aperture we use for our most commonly printed symbol, the ITF-14.

— Make sure you are using the correct aperture for the symbology (and in some cases the Symbology and its magnification factor) that you are printing. In addition, make sure your customers understand that they must also use the correct aperture size.

— Grades of less than C (1,5) for all characteristics other than Symbol Contrast should be investigated when direct contact printing bar code symbols on natural kraft. Particular attention should be paid if the "Decodability" characteristic is below a C (1,5). Decodability is a measure of how much of the allowable tolerance is being taken up by the printed bars and created spaces. A poor Decodability grade may indicate excess printing plate pressure or a defective printing plate.

NOTE 14: In-line, real time bar code "scanning" systems are now being advertised. Potential purchasers should inquire as to whether these systems provide full ISO/ANSI "verification". It is possible that off-line ISO/ANSI "verification" may still be required even if automated "scanning" systems are in place.

A.8 Ink jet printing

Our industry frequently has problems when customers opt to print bar code symbology on generic cases using ink jet technology. Ink jet equipment suppliers often persuade the customer to complain to corrugated

suppliers that the ink jet printed bar codes have a high “non-scan” rate because of some fault with our substrate (usually our kraft-coloured linerboard).

A.9 Note the following:

— Ink jet ink is not a true ink as we know it. It is more of a dye. The pigments in inks would quickly clog the ink jet nozzles. A comparison on standard draw down paper shows that ink jet “ink” is more of a dark gray than a true black. Thus symbol contrast can be a bigger issue with ink jet printing when compared to direct contact printing.
— Because of the nature of the “ink”, there is a tendency for ink jet “ink” to “spread” or “wick” more than direct printed ink. This “wicking” can cause finished bar width dimensions to be wider than the symbol tolerances allow.

— The ink jet nozzles can be set so that they are too far away from the box. This situation can also cause ink wicking and its resultant bar width dimensional problems.

— Ink jet printers can have quiet zone problems, just as we can.

A plant’s best course of action is to periodically ask bar code customers if they are considering using ink jet printing technology. If the answer is “yes” or even “maybe”, ask to get in on the ground floor in their deliberations. In this way, boxmakers can offer constructive suggestions (including trials and pilot programs) before any investment is made rather than being forced to react to circumstances following installation.

A technique that can be used to improve symbol contrast and minimize “wicking” for ink jet application situations is to print a white “block” slightly larger than the space required for the ink jet bar code. This technique is also discussed in the “Printing Plates-Areas of Disagreement” section of this document.

Table 3 — Table of recommended sizes for direct contact bar code printing

Code	Sizes and Comments	
ITF-14	80%-100%	Acceptable
	70%	Marginal
	50% and 62½%	Do not print as the tolerances are too narrow for our printing process. Further, the ISO/ANSI passing grade requirement changes from “D” to “C” for the 50% size. The ISO/ANSI “C” grade cannot be achieved on kraft-coloured liners.
UPC-A & EAN-13	180%-200%	Acceptable (exception – see note below)
	160%-170%	Marginal
	<160%	Do not print as the tolerances are too narrow for our printing process.
	NOTE: All UPC-A & EAN-13 bar codes require an ISO/ANSI “C” grade to pass. The “C” grade cannot be achieved when printed on natural kraft-coloured substrates.	
Code-128 (GS1-128)	Narrow bar ≥ 0,635 mm	Acceptable (exception – see note below)
	Narrow bar < 0,635 mm	Do not print as the tolerance range is too narrow for our process.
	NOTE: All Code 128 bar code symbols require an ISO/ANSI “C” grade to pass. The “C” grade cannot be achieved when printed on natural kraft-coloured substrates.	
Code 39	Narrow bar ≥ 0,51 mm	Acceptable
	Narrow bar < 0,51 mm	Do not print as the tolerances are too narrow for our printing process.

*NOTE: Because applications for Code 39 are not controlled by the GS1, please consult, or have your customer consult, the Application Standard that you must meet for Code 39 bar code quality

including ISO/ANSI passing grade requirements, aperture size and the light source wavelength (660 nm).

A.10 Addendum

— A request to change the nominal light source wavelength from 670 ± 10 nm to 660 ± 10 nm is being debated. Many retail scanners operate at the 650 nm wavelength and a specification change would allow the formal inclusion of those scanners into the system. Further, the light source specified in the international calibration standard to calibrate bar code test templates is 660 nm. This proposed change, if implemented, would not have any practical impact on direct contact printing of bar codes on corrugated. The specifications in this document do reflect this proposed change.

— A change is being deliberated to use the 20 mil (0,51 mm) aperture for Code 128 symbols with nominal narrow bars of ≥ 0,51 mm. This proposed change would help corrugated printers if implemented. The specifications in this document do not reflect this proposed change.

— Some bar code industry gurus are giving thought to lowering the acceptance criteria of Code 128 symbols with nominal narrow bars of ≥ 0,51 mm to a 1,0 (half-way between a “C” and a “D”) or to even a 0,5 (“D”) grade. If implemented, this change would definitely benefit the corrugated industry. The specifications in this document do not reflect this proposed change.

Annex B
(normative)

Organizations relevant to this International Standard

B.1 ANSI

American National Standards Institute, 1819 L Street, NW, Suite 600, Washington, DC 20036,
Tel: +1 212 642 4900; Web: http://www.ansi.org/.

B.2 ASC MH 10

An ANSI-accredited committee responsible for the development of American national standards on unit-load and transport-package sizes, package testing standards, definitions and terminology, standardization of unit-load height, sacks and multi-wall bag standards, coding and labelling of unit-loads.

Web: http://www.autoid.org/ANSI_MH10/Default.htm

B.3 ASC MH 10/SC 8

An ANSI-accredited committee responsible for the development of American national standards on the coding and labelling of transport packages and unit loads, product packaging, and radio frequency identification for returnable containers. ASC MH 10/SC 8 serves as the US Technical Advisory Group (TAG) to ISO/TC 122.

Web: http://www.autoid.org/ANSI_MH10/ansi_mh10sc8.htm

B.4 EDIFICE - The European B2B Forum for the Electronics Industry

The Standardized Electronic Commerce Forum for companies with interests in electronics, computing and telecommunication. It is the European industry standardization group for the computing, electronics, and telecommunications industry.

EDIFICE, Tiensestraat 2, 3320 Hoegaarden, Belgium. Tel: +32 16 76 54 40; Fax: +32 16 76 53 58;
E-mail: dora.cresens@edifice.org, Web: www.edifice.org

B.5 GS1

Based in Brussels, Belgium, an organization of GS1 Member Organizations that manages the GS1 System.

Blue Tower, Avenue Louise, 326 BE 1050, Brussels, Belgium. Telephone: +32 2 788 7800, Email: info@gs1.org, Web: http://www.gs1.org/

B.6 HIBCC

HIBCC (Health Industry Business Communications Council) develops and maintains standards for use in the health industry.

HIBCC, 2525 E. Arizona Biltmore Circle, Suite 127, Phoenix, Arizona 85016. Tel: (602) 381 1091, Email: info@hibcc.org, Web: http://www.hibcc.org/

B.7 Japanese Industrial Standards Committee

The Japanese standards body responsible for the development of specific Japanese standards, such as those providing a technical specification for a bar code symbology.

Japanese Industrial Standards Committee (JISC), 1-3-1 Kasumigaseki, Chiyoda-ku, Tokyo 100-8901, Japan. Web: http://www.jisc.go.jp/.

B.8 JEITA

Japan Electronics & Information Technology Industries Association; Chiyoda First Bldg South Wing, 2-1,Nishi-Kanda 3-chome,Chiyoda-ku, Tokyo 101-0065, Japan; Telephone: +81-3-5212-8257; Facsimile: +81-3-5212-8259; Web: http://ec.jeita.or.jp/eng/

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

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

[6] ISO/IEC 15459-1, *Information technology — Unique identifiers — Part 1: Transport units*

[7] ISO/IEC 15459-3, *Information technology — Unique identifiers — Part 3: Common rules*

[8] ISO/IEC 15459-4, *Information technology — Unique identifiers — Part 4: Individual items*

[9] ISO/IEC 15459-5, *Information technology — Unique identifiers — Part 5: Returnable transport items (RTIs)*

[10] ISO/IEC 15459-6, *Information technology — Unique identifiers — Part 6: Product groupings*

[11] ISO/IEC 15459-8, *Information technology — Unique identifiers — Part 8: Grouping of transport units*

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