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Packaging — Labelling and direct product marking with linear bar code and two-dimensional symbols

Emballage — Étiquetage et marquage direct sur le produit avec un code à barres et des symboles bidimensionnels

Please see the administrative notes on page iii

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Contents

Page

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.

ISO 28219 was prepared by Technical Committee ISO/TC 122, *Packaging*.

Introduction

Today, global industries widely use machine-readable markings on products for inventory control, quality control, and product life cycle management. Common technologies, data structures, conformance, and applications standards are necessary to enable all trading partners to use such markings internally and throughout the supply chain.

A number of different product labelling and marking 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 standard linear bar code or two-dimensional symbol marked on a product or part will facilitate the automation of inventory control, quality control, and product life cycle management. The linear bar code or two-dimensional symbol information on the product may be used as a key to access the appropriate database that contains detailed information about the product, including information transmitted via EDI. In addition a product mark may contain other information as agreed between the trading partners.

Packaging — Labelling and direct product marking with linear bar code and two-dimensional symbols

1 Scope

This International Standard

— defines minimum requirements for identifying items;

— provides guidelines for item marking with machine-readable symbols;

— covers both labels and direct marking of items;

— includes testing procedures for label adhesive characteristics and mark durability;

— provides guidance for the formatting on the label of data presented in linear bar code, two-dimensional symbol or human readable form;

— is intended for applications which include, but are not limited to, support of systems that automate the control of items during the processes of:

  — production;

  — inventory;

  — distribution;

  — field service;

  — point of sale;

  — repair, and

— is intended to include, but it is not limited to, multiple industries including:

  — automotive;

  — aerospace;

  — chemical;

  — consumer items;

  — electronics;

  — health care;

  — marine;

  — rail;

  — telecommunications.

The location and application method of the marking are not defined (these will be reviewed and agreed upon by suppliers and manufacturers and their trading partners before implementing this International Standard).

This International Standard does not supersede or replace any applicable safety or regulatory marking or labeling requirements. This International Standard is meant to satisfy the minimum item marking requirements of numerous applications and industry groups and as such its applicability is to a wide range of industries, each of which may have specific implementation guidelines for it. This International Standard is to be applied in addition to any other mandated labeling direct-marking requirements.

The labeling and direct marking requirement of this International Standard and other standards can be combined labeling into one label or marking area or appear as separate labels or marking areas.

This International Standard uses the terms “part marking” and “item marking” interchangeably. Unless otherwise stated, this document will use the term “item marking” to describe both the labeling and direct part marking (DPM) of an item, where DPM includes, but is not limited to, altering (e.g. dot peen, laser etch, chemical etch) as well as additive type processes (e.g. ink jet, vacuum deposition).

The purpose of this International Standard is to establish the machine-readable (linear, two dimensional, and composite symbols) and human readable content for direct marking and labeling of items, parts, and components.

This International Standard provides a means for items, parts and components to be marked, and read in either fixtured or handheld scanning environments at any manufacturer’s facility and then read by customers purchasing items for subsequent manufacturing operations or for final end use. Intended applications include, but are not limited to supply chain applications, e.g. inventory, distribution, manufacturing, quality control, acquisition, transportation, supply, repair, and disposal.

The figures are illustrative and not necessarily to scale or to the quality requirements specified in this International Standard.

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 Processing — ISO 7-Bit Coded Character Set for Information Interchange*

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

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

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

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

ISO/IEC 15418, *Information technology, Automatic identification and data capture techniques — GS1 Application Identifiers and ASC MH10 Data Identifiers*

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

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

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

ISO/IEC 16022, Information technology — *Automatic identification and data capture techniques — Bar code symbology specification — Data Matrix*

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

ISO/IEC 18004, Information technology — *Automatic identification and data capture techniques — QR Code 2005 bar code symbology specification*

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

ISO 21067, *Packaging — Vocabulary*

ISO/IEC 24723, *Information technology — Automatic identification and data capture techniques — Bar code symbology specification — Composite component*

ISO/IEC 24728, *Information technology — Automatic identification and data capture techniques — Bar code symbology specification — MicroPDF417*

ANS MH10.8.2, *Data Application Identifier Standard*

AIM DPM-1, *Direct Part Mark (DPM) Quality Guideline*

ASTM D1000-93, *Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications*

Dun & Bradstreet, *DUNS® Number*

GS1 *General Specifications*

International Symbology Specification — *GS1 Composite Symbology*

NAMSA, *ACodP-1(D)*, Chapter 2, Subsection 242-243, (NCAGE)

3 Terms and definitions

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

3.1
cell
smallest element of a two-dimensional matrix symbol

3.2
CLEI™ code
coding structure maintained by Telcordia that identifies communications equipment, in a concise, uniform feature-oriented language, describing product type, features, source document and associated drawings and vintages

3.3
components
parts (bare printed circuit board, integrated circuits, capacitor, diodes, switch, valve, spring, bearing, bracket, bolt, etc.) of a first level/modular assembly

3.4
data element separator
specified character used to delimit discrete fields of data

3.5
first level
modular assembly
manufactured item (populated printed circuit board, hydraulic pump, starter, dashboard assembly, door assembly, etc.) made up of components

3.6
intrusive marking
device designed to alter a material surface to form a human- or machine-readable symbol

NOTE Intrusive marking includes, but is not limited to, devices that abrade, burn, corrode, cut, deform, dissolve, etch, melt, oxidize or vaporize a material surface. Intrusive marking methods include laser etch, chemical etch, dot peen and micro-sandblast.

3.7
item
product
first level or higher assembly that is sold in a complete end-usable configuration

3.8
label
adhesive backed media capable of being marked with information in machine-readable and/or human-readable form

NOTE Both labels and direct marking methods are referred to in this International Standard under the term “label”.

3.9
manufacturer
actual producer or fabricator of an item; not necessarily the supplier in a transaction

3.10
non-intrusive marking
method of forming markings by adding material to a surface

NOTE Non-intrusive marking methods include ink jet, laser bonding, liquid metal jet, silk screen, stencil and thin film deposition.

3.11
supplier
party that produces, provides, or furnishes an item or service

3.12
syntax
manner in which data is put together to form messages

NOTE 1 Syntax also includes rules governing the use of appropriate identifiers, delimiters, separator character(s), and other non-data characters within the message.

NOTE 2 Syntax is the equivalent to grammar in spoken language.

4 Requirements

4.1 Identification

4.1.1 General

Enterprises may choose to assign uniqueness to items at the individual, group, or product level. Individual uniqueness requires serialization or one-of-a-kind production, see 4.1.2 and 4.2.2.2. A lot or batch number

captures group uniqueness, see 4.1.3 and 4.2.2.2. A product code is an example of item uniqueness, see 4.2.2.3.

4.1.2 Unique item identification

Items may be assigned a unique item identification code to each instance of the item, i.e. serialization. Serial numbers shall be unique either within an enterprise ID or within enterprise ID + part number. When using unique identification, the encoded symbol shall contain only one enterprise identifier, serial number and/or original part number to avoid confusion and ensure uniqueness.

4.1.3 Lot or batch identification

Items can have group uniqueness applied by an enterprise. Some items are assigned group identification, e.g. lot or batch number.

4.2 Data format common requirements

Those implementing this International Standard should refer to the guidelines for their particular industries. For a partial list of industry guidelines see the bibliography.

4.2.1 General format

Labels will accommodate both mandatory and optional data fields. The maximum length of each discrete data field shall be 25 data characters unless otherwise specified. This character count is exclusive of overhead characters.

All data elements encoded in a machine-readable medium shall be preceded by the appropriate data identifier (DI) as defined in ISO/IEC 15418 and ANS MH10.8.2 Data Identifier, or the appropriate application identifier (AI) defined in ISO/IEC 15418 and the GS1 General Specifications. The exceptions to this rule are the UPC-A, UPC-E, EAN-8, and EAN-13 symbologies.

The choice between DIs and GS1 AIs, for any user, will normally be determined in the applicable industry convention being followed.

Other industries developing item identification conventions should consider business practices, information requirements and systems capabilities of the trading partners in choosing between DIs and GS1 AIs.

4.2.1.1 Data identifiers (DIs)

The descriptions in the DI 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 DIs and the full specification for their use are found in the American National Standard 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.

4.2.1.2 GS1 Application Identifiers (AIs)

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

The GS1 item identification system and related encoding standard are complemented by the GS1 maintained AIs. This International Standard comprises two principal elements, which 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-sector 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, three or four characters. The first two digits of the AI 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 is contained within the GS1 General Specifications.

ISO/TC 122 has approved the use of ISO/IEC 15418, since through its normative references it encompasses the GS1 General Specifications.

Subclause 3.6.58 of the GS1 General Specifications, Information Mutually Agreed Between Trading Partners (Including FACT DIs): AI (90), states that the data field shows the information agreed between the two trading partners, and may also be used to incorporate data preceded by FACT (ASC MH10) DIs. The ambiguity existing as to whether the information that follows AI (90) is a DI or another type of trading partner information makes the AI (90) solution to identify ASC MH10 DIs unworkable.

ISO/TC 122 values the formal GS1 approval process and has submitted a proposal to the GS1 GSMP seeking approval of a new format for the DI addition. That approval process is lengthy, and, in the interim, a collaborative solution is necessary to create a near-term interoperable environment.

ISO/TC 122 has requested a specific AI to signify that what follows is in fact an ASC MH10 DI. ISO/TC 122 has established the collaborative solution, the application identifier “DI”, to enable the use of DIs using AIs until such time as an AI is assigned to specifically indicate the use of DIs in the GS1 Generation Specifications.

This solution uses the structure of GS1 Generation Specifications as an acceptable semantic standard and the business rules in the GS1 Generation Specifications. When approved, the new AI shall be used and replace the interim “DI” application identifier format.

Consideration and decisions on coding approaches should carefully weigh any impacts to changing from the “DI” application identifier format to an approved future AI against any associated costs and strategic near term coding requirements. The use of the collaborative solution AI as described below should strictly be considered an interim approach.

4.2.1.3 Organization inclusion in coding

It is recommended that data structures used to identify items or the traceability of items include identification of the organization providing the coding as well as the specific coding structure.

In the GS1 General Specifications this coding structure is the GS1 Company Prefix portion of the global trade item number (GTIN).

When using DIs, this coding structure uses the issuing agency code (IAC) established in ISO/IEC 15459-2 and the company identification number (CIN) assigned by the issuing agency.

4.2.2 Mandatory data fields

Mandatory data fields are given in Table 1.

Table 1 — Item identification code type

Item identification type	Mandatory fields
1. Commodity	Item identification code (example nails)
2. Non-traceable	Enterprise identification code Item identification code
3. Group traceability	Enterprise identification code Item identification code Unique lot or batch traceability code
4. Unique serialization within item identification code	Enterprise identification code Item identification code Unique individual item identification code
5. Unique serialization within enterprise	Enterprise identification code Unique item traceability code within enterprise identification code

The enterprise identification code and item identification code may be combined in a single data field, see 4.2.2.3.

4.2.2.1 Enterprise identification code

The enterprise identification code shall use formats contained in Table 2 and Table 3. The use of more than one enterprise identification code is permitted on an item preceded by DI 20V. The choice of enterprise identification code(s) should be mutually agreed upon between trading partners. The appropriate DI shall precede the enterprise identification when separate data fields are used to identify the supplier and the item identification.

Table 2 — Data identifiers used for enterprise identification

Data identifier	Data field	Data characteristics Type followed by the number of characters e.g. a#, n#, an#) [a]	Description
18V	Combined IAC/CIN	an3+an1..3+an3..13	Combined IAC/CIN
12V	DUNS® number Identifying Manufacturer	an3+n9	Entity (manufacturer) identification assigned by Dun and Bradstreet
17V	U.S. Department of Defense (DoD) CAGE Code/NAMSA NCAGE	an3+an5	Company identification assigned by the U.S. Department of Defense
20V	Company identification	an3+an1..3+ an3..13+“+”+an3	Combined IAC/CIN and Party Qualifier Code (EDIFACT DE 3035)
21V	Supplier identification	an3 +an...25	Combined IAC/CIN followed by an internally assigned entity identification

[a] The characters before the first “+” symbol describe the format of the DI or AI. Note that the “+” symbols are not encoded in the data.

Table 3 — Application Identifiers used for enterprise identification

Application Identifier	Data Field	Data characteristics Type followed by the number of characters e.g. a#, n#, an#) [a]	Description
N/A	Part number (supplier/item) UPC-A (GTIN-12)	n12 (See Annex E)	UPC-A/UPC-E Symbology (combination of supplier & item identification)
N/A	Part number (supplier/item) EAN-13 (GTIN-13)	n13 (See Annex E)	EAN-13 Symbology (combination of supplier & item identification)
01	Part number (supplier/item) GTIN-14 (GTIN-14)	n2+n14	GS1-128 (combination of supplier and item)

[a] The characters before the first "+" symbol describe the format of the DI or AI. Note that the "+" symbols are not encoded in the data except for "+" in 20V.

4.2.2.2 Group and item traceability codes

The traceability code is assigned by the supplier to identify a unique item or group of entities (e.g. lot, batch, date code, revision level or serial number). The DIs or AIs given in Table 4 and Table 5 represent a partial list of the ASC MH10 Data Identifiers and GS1 Application Identifiers that may be applicable to traceability codes.

The traceability data field is assigned by the manufacturer or supplier. The maximum length of a single traceability data field shall be 20 characters, which excludes the associated DI or AI. Concatenated fields, e.g. IAC/CIN plus serial number, shall not exceed 35 characters.

Table 4 — Data identifiers used for traceability

Data Identifier	Data Field	Data characteristics Type followed by the number of characters e.g. a#, n#, an#) [a]	Description
S	Serial number	an1+an...20	Serial number or code assigned by the supplier to an entity for its lifetime
18S	Serial number within CAGE Code	an3+an...20	Serial number or code assigned by the CAGE Code that is unique within CAGE Code
20S	Customer assigned serial number	an3+an...20	Serial number or code assigned by the customer to an entity for its lifetime
25S	Serial number	an3 +IAC/CIN+an...20	Combined IAC/CIN and the serial number assigned by the supplier
1T	Lot/batch number	an2+an...20	Lot/Batch Number defined by the manufacturer
25T	Lot/batch number	an3 +IAC/CIN+an...20	Combined IAC/CIN and enterprise identification and lot or batch number assigned by the supplier
+$	Lot/batch number	a2+an..15	Options of concatenated lot or batch combinations with item data are specified with ANSI/HIBC 2
20S may be used by industries that are serializing items that were not serialized by the manufacturer at time of manufacturing. Asset identifiers shall be used for any other purpose and shall remain unique for a period well beyond the lifetime of relevant records. If a company assigns asset identifiers to trade items supplied to its customers, the company shall ensure that the asset identifiers are never reused. The length specified in the table may be shorter than the length specified in the reference standard, however, that is the maximum length specified in this International Standard.			
NOTE 1 The variable lengths for the IAC/CIN combined lengths are defined by ISO 15459. NOTE 2 Traceability codes are not always mandatory for GS1 implementations.			
[a] The characters before the first "+" symbol describe the format of the DI or AI. Note that the "+" symbols are not encoded in the data.			

Table 5 — Application identifiers used for traceability

Application Identifier	Data Field	Data characteristics Type followed by the number of characters e.g. a#, n#, an#) [a]	Description
10	Batch/lot number	n2+an...20	Traceability code defined by the manufacturer
11	Production date	n2+n6 [b]	Production date
21	Serial number	n2+an...20	Serial number or code assigned by the supplier to an trade item for its lifetime
414	Global location number	n3+n13	Global location number (GLN) to be processed according to the particular application requirements
8003	Global returnable asset identifier	n4+n14+an..16	Global returnable asset identifier (GRAI)
8004	Global individual asset identifier	n4+an...30	Global individual asset identifier (GIAI)
20S may be used by industries that are serializing items that were not serialized by the manufacturer at time of manufacturing. Asset identifiers shall be used for any other purpose and shall remain unique for a period well beyond the lifetime of relevant records. If a company assigns asset identifiers to trade items supplied to its customers, the company shall ensure that the asset identifiers are never reused. The length specified in the table may be shorter than the length specified in the reference standard, however, that is the maximum length specified in this International Standard.			
NOTE 1 The variable lengths for the IAC/CIN combined lengths are defined by ISO 15459. NOTE 2 Traceability codes are not always mandatory for GS1 implementations.			
[a] The characters before the first "+" symbol describe the format of the DI or AI. Note that the "+" symbols are not encoded in the data. [b] Production Date code construction using GS1 Application Identifiers use a two-digit designation for year. Users wishing more information on the GS1 implementation of Year 2000 issues should contact GS1.			

4.2.2.3 Item identification

The maximum length of the Item Identification shall be 20 data characters unless otherwise specified in this document or agreed to between trading partners. This maximum excludes the associated DI or AI. Item identification codes may be concatenated with the enterprise identification to produce a unique item identification. See Tables 2 to 5 for IAC/CIN.

The item identification code (e.g. supplier or customer part number) shall be designated as mutually agreed upon between the supplier or manufacturer and customer. The supplier's part number is the recommended item identification code.

An item identification code may be concatenated with the company prefix to produce a unique item identification code. GTIN-12 and GTIN-13 formats are fixed length numeric examples of company prefix codes concatenated with item identification codes to provide worldwide item identification uniqueness.

Likewise, variable length examples of a fixed length enterprise identification codes concatenated with a variable length alphanumeric item identification codes to provide worldwide item identification uniqueness may be provided with DIs such as "9P" and "17P". See Table 6.

Table 6 — Data identifiers

Data identifier	Data field	Data characteristics Type followed by the number of characters e.g. a#, n#, an#) [a]	Description
P	Part number	an1+an...20	Customer assigned part number
1P	Part number	an2+an...20	Supplier assigned part number
8P	Part number	an2+n14	GS1 GTIN-14
9P	Part number	an2+n9+an...16	Combined DUNS®-9 supplier identification and item code assigned by the supplier
11P	Part number	an3+an10	CLEI™ code for telecommunications equipment
17P	Part number	an3+an7+an...20	Combined GS1 company prefix and item code assigned by the supplier
25P	Product number	an3+IAC/CIN+an...20	Combined IAC/CIN and item code assigned by the supplier
+	Product number	a1+an..19	HIBCC

NOTE Whilst GS1 permits AI "241" to be a maximum of 30 characters, the customer assigned part number should be limited to no more than 25 characters.

[a] The characters before the first "+" symbol describe the format of the DI or AI. Note that the "+" symbols are not encoded in the data.

Table 7 — Application identifiers

Application identifier	Data field	Data characteristics Type followed by the number of characters e.g. a#, n#, an#) [a]	Description
N/A	Part number (supplier/item) GTIN-12/GTIN-13	n13 (see Annex E)	UPC-A/EAN-13 Symbology (combination of supplier & item identification)
N/A	Part number (supplier/item) UPC-A/UPC-E (GTIN-12)	n12 (see Annex E)	UPC-A/UPC-E Symbology (combination of supplier & item identification)
N/A	Part number (supplier/item) EAN-13 (GTIN-13)	n13 (see Annex E)	EAN-13 Symbology (combination of supplier & item identification)
01	GTIN-14 (supplier/item & quantity)	n2+n14	GS1-128 (combination of indicator digit, supplier, and item identification)
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.
8018	Global service relation number (GSRN)	n4+n18	GS1 identification number of a service relation (GSRN) to be assigned by the service provider

NOTE Whilst GS1 permits AI "241" to be a maximum of 30 characters, the customer assigned part number should be limited to no more than 25 characters.

[a] The characters before the first "+" symbol describe the format of the DI or AI. Note that the "+" symbols are not encoded in the data.

4.2.3 Optional data fields

Specific applications and trading partner agreements may require additional data fields. See Table 8 and Table 9 for examples.

When using DIs or AIs to encode country of origin, it shall be in one of the formats shown in Table 8 or Table 9.

Table 8 — Data identifiers for optional data

Data identifier	Data field	Data characteristics Type followed by the number of characters e.g. a#, n#, an#) [a]	Description
4L	Country of origin	an2+an2	The two-character country code as defined by ISO 3166. The country of origin is defined as the manufacturing country wherein the product obtained its present identity as a part, subassembly, or finished product.
6D	Defined date	an2+n8+an3	ISO format YYYYMMDD immediately followed by an ANSI X12.3 Data Element Number 374 Qualifier providing a code specifying type of date (e.g. ship date, manufacture date)
14D	Expiration date	an3+n8	Expiration date (YYYYMMDD)
16D	Production date	an3+n8	Production date (YYYYMMDD)
30P	First level additional item identification	an3+an…20	First level (supplier assigned) item identification (item ID), which is different than or in addition to Item ID provided by “1P”

[a] The characters before the first “+” symbol describe the format of the DI or AI. Note that the “+” symbols are not encoded in the data.

Table 9 — Application identifiers for optional data

Application Identifier	Data Field	Data characteristics Type followed by the number of characters e.g. a#, n#, an#) [a]	Description
422	Country of origin	n3+n3	The three-digit country code as defined by ISO 3166. The country of origin is defined as the manufacturing country wherein the product obtained its present identity as a part, subassembly, or finished product.
423	Country of initial processing (with ISO country code)	n3+n..15	ISO country codes stating the countries of initial processing of a trade item. The n..15 code may be 3,6,9,12,15 characters long depending on number of processing countries.
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
17	Expiration date	an3+n8	
11	Production date	an3+n8	

[a] The characters before the first “+” symbol describe the format of the DI or AI. Note that the “+” symbols are not encoded in the data.

4.2.4 Syntax

4.2.4.1 Linear bar code symbol data field syntax

Data encoded in the EAN/UPC symbology includes no identifiers. A Data Identifier, as per ANS MH10.8.2, shall precede data encoded in the Code 39 symbology, as described in ISO/IEC 16388. Data encoded in GS1-128 symbology shall be formatted as defined in GS1 General Specification preceded by an Application Identifier. Data encoded in Code 128, as described in ISO/IEC 15417, not using GS1 Application Identifiers shall be preceded by a Data Identifier per ANS MH10.8.2. Data encoded in UPC-A symbology shall be in accordance with GS1 General Specification.

4.2.4.2 Concatenation of multiple data fields

When concatenating data in a linear bar code symbol the total length should be limited to 32 data characters, including the associated DIs and AIs and concatenation characters but not including symbology overhead characters. If the length exceeds the 32-character maximum message length, two-dimensional symbols should be used.

a) When concatenating data in a linear bar code message, the appropriate data element separator shall be used in accordance with the specific industry standard. The maximum length of the concatenated data field is limited by the symbology, the reading technology, and the available space.

b) Specific data or AIs are assigned to accommodate concatenation of specific fixed length data fields.

c) When variable length data fields need to be concatenated using the Code 39 symbology, the plus "+" character (ASCII Decimal 43) should be used to delineate between data fields, per ANS MH10.8.2.

d) When multiple variable length data fields need to be concatenated using the Code 128 symbology with DIs, the plus "+" character (ASCII Decimal 43) should be used to delineate between data fields, as per ANS MH10.8.2 (ISO/IEC 15418).

e) When multiple variable length data fields need to be concatenated using the GS1-128 symbology, the function one "FNC1" character (transmitted as "$^{G}_{S}$" ASCII Decimal 29) is used to delineate between data fields.

4.2.4.3 Two-Dimensional symbology data field syntax

Data encoded to be compliant with this International Standard shall use the syntax identified in ISO/IEC 15434. The header (first 7 characters "[)>$^{R}_{S}$ 06 $^{G}_{S}$") and trailer (the last 2 characters "$^{R}_{S}$ $^{E}O_{T}$") are fixed for this application, in accordance with the ANS ISO/IEC 15434 standard, when Data Identifiers are used within the message. The header (first 7 characters "[)>$^{R}_{S}$05 $^{G}_{S}$") and trailer (the last 2 characters "$^{R}_{S}$ $^{E}O_{T}$") are fixed for this application, in accordance with the ANS ISO/IEC 15434 standard, when Application Identifiers are used within the data encoding. The "$^{R}_{S}$" character is ASCII/ISO 646 Decimal 30. The "$^{E}O_{T}$" character is ASCII/ISO 646 Decimal 04. All characters supported by this International Standard are shown in Annex C. Certain symbologies support the use of a single codeword to encode the header and trailer character strings. Refer to applicable symbology standards. The use of structures combining different formats shall be as defined in ISO/IEC 15434.

When combining data fields within a two dimensional symbol, the "$^{G}_{S}$" (ASCII/ISO 646 Decimal 29) character shall be used with the appropriate DI or AI to identify each of the combined fields. The exception to this requirement may be GS1 data carriers (e.g. composite symbology) that do not encode data in accordance with ISO 15434. It is incumbent upon the reader to transmit the data to the application in an ISO/IEC 15434 syntax.

4.3 General layout and location

4.3.1 Layout

Layout refers to the positioning of the fields on the label. Layout of bar code symbols or two-dimensional symbols will depend on the available space on the item and other factors such as industry sector business rules, trading partner agreements or customer labeling requirements.

4.3.2 Location

Location refers to the positioning of the label on the item. Each label should be located in a position that facilitates scanning without degrading the safety or performance of the item. Consideration should be given to reading the symbol in the item's installed position.

4.3.3 Linear bar code titles

Titles are recommended for all linear bar code fields. When DIs are used, the title shall include the appropriate DI, enclosed in parentheses, e.g. (1P) PART # SPLR. When AIs are used, the AI is part of the human readable interpretation, not as part of the title. Titles shall be in accordance with ISO/IEC 15418. Titles may be positioned above or below the bar code symbol in accordance with industry guidelines and application standards.

If the physical space available for marking is insufficient to support the marking of the title, and the user is employing linear bar code symbols, the title may be abbreviated to only include the DI enclosed in parentheses. Where physical space for marking is extremely limited the title may be eliminated.

4.3.4 Human-readable interpretation

For linear bar codes, the human-readable interpretation should be printed adjacent to the symbol. The human-readable interpretation of the data encoded shall be printed legibly. The recommended height of the upper case alpha characters is 2 mm. The minimum height of the upper case alpha characters shall be 1,25 mm.

For bar code symbols, when DIs are used, the human-readable interpretation shall include all of the data within the bar code symbol, less the DI. See Figure 1.

Figure 1 — Bar code symbol example with data identifier

When an AI is used, the human-readable interpretation shall include the data as well as the AI in parentheses. See Figure 2.

Figure 2 — Bar code symbol example with application identifier

For two-dimensional symbols, portions of the data should be shown in the human-readable interpretation when necessary or required by application or industry standards. However, the interpretation of the GTIN when using GS1 data structures shall use a human-readable interpretation of two-dimensional symbols.

4.4 Symbol requirements

4.4.1 Symbology recommendations

Any of the symbologies identified in this International Standard may be used for any direct part-marking technique. Only matrix symbologies (e.g. data matrix) should be used for direct part-marking techniques.

4.4.2 Linear bar code symbol requirements

The linear symbologies specified in this International Standard are Code 39, UPC-A and E, EAN-13, EAN-8, GS1-128, Code 128, and the GS1 Data Bar family. Users contemplating applications of Code 128 with DIs should familiarize themselves with the issues identified in Annex F. See Figures 3 to 8.

Figure 3 — UPC-A symbol

Figure 4 — EAN-13 symbol

Figure 5 — GS1-128 symbol

Figure 6 — Code 39 symbol

Figure 7 — Code 128 symbol

Figure 8 — GS1 Data Bar-14 symbol

4.4.2.1 "X" dimension

The narrow element dimension (X dimension) range should be from 0,19 mm to 0,51 mm as determined by the printing capability of the supplier/printer of the label. EAN/UPC symbols are an exception to this; for printing of EAN/UPC symbols the narrow element dimension range should be from 0,264 mm to 0,66 mm. Note that at the smaller X dimensions, care must be given to match the X dimension to an integer multiple of the resolution of the printer. Conformance to bar code print quality requirements shall be determined according to 4.4.2.4.

4.4.2.2 Symbol height

Bar code symbol height should be no less than 15 % of the length of the bar code symbol.

EAN/UPC symbols symbol height range should be from 20,73 mm to 51,82 mm.

4.4.2.3 Quiet zone

The linear symbol should have minimum quiet zones of 6,4 mm adjacent to the start and stop characters. To enable the user to easily scan the bar code symbol, quiet zones shall be a minimum of ten times the narrow element width (X dimension).

UPC-A and EAN-13 symbols shall have quiet zones as follows:

a) EAN-13 symbols: left, 11X; right, 7X;

b) UPC A symbols: 9X

4.4.2.4 Character set

The allowable character set for linear bar code data fields identified with ASC MH10.8.2 Data Identifiers are the upper case alphabetic characters A to Z and the numeric characters 0 to 9, unless otherwise identified in the DI definition. This is in addition to any recommended field separators, record separators, segment terminators and compliance indicator.

The allowable character set for linear bar code data fields identified with GS1 Application Identifiers are the upper case alphabetic characters A to Z and the numeric characters 0 to 9, unless otherwise identified in the AI definition. This is in addition to any recommended field separators, record separators, segment terminators and compliance indicator.

The allowable character set for the EAN/UPC and ITF-14 linear bar code symbols are the numeric characters 0 to 9.

4.4.2.5 Print quality

Linear bar code print quality shall be measured in accordance with ISO/IEC 15416 in the visible light range (660 nm). The minimum overall symbol print quality grade shall be 1,5 (C) using the appropriate measuring aperture as recommended in the ISO/IEC 15416 standard. When measuring EAN/UPC symbols the recommended aperture size is 0,150 mm.

If the intent is to read symbols through translucent packaging, the minimum symbol grade shall be met when scanned through the packaging. This requirement is to ensure that the symbol can be read when scanned through protective packaging, such as an electrostatic discharge (ESD) container for circuit boards.

4.4.3 Two-dimensional symbol requirements

The two-dimensional symbols specified in this document are Data Matrix ECC 200, QR Code, and MicroPDF417. The encoding of data in Data Matrix ECC 200 shall be in accordance with ISO/IEC 16022 using ECC 200. The encoding of data in MicroPDF417 shall be in accordance with ISO/IEC 24728. The encoding of data in QR Code shall be in accordance with ISO/IEC 18004.

The encoding of data shall follow the ISO 5434 message format and syntax rules.

4.4.3.1 Data matrix symbol requirements

The data matrix symbols referenced in this document are defined in ISO/IEC 16022.

Figure 9 — Data Matrix ECC 200 symbol

4.4.3.1.1 "X" dimension

The appropriate X dimension for a symbol is determined by many factors including marking area available, surface type, environment and reading device(s) used. The X dimension of a Data Matrix ECC 200 symbol is equivalent to the cell size. It is recommended that the user implement their system using the largest X dimension that will enable the symbol to fit in the available area. The minimum open system X dimension shall be 0,13 mm. X dimension sizes below 0,19 mm or greater than 0,38 mm are not recommended because these symbols may be difficult to scan in an open-systems environment. Regardless of the element width the symbol shall meet the symbol quality requirements of 4.4.3.1.6.

4.4.3.1.2 Element height

The height of any individual cell of the Data Matrix ECC 200 symbol should be equal to the X dimension.

4.4.3.1.3 Symbol size

The symbol size should not be greater than 12 mm by 12 mm. The reason for this size is to establish a known field of view for reading the label or mark.

The user should implement their system using the largest X dimension that will enable the symbol to fit in the available area, up to the maximum dimensions shown in Table 10. This will allow for the best possible scanner performance. The particular symbol size that is printed will depend on the amount and type of data encoded. The character count in Table 10 includes data overhead characters (specifically, message header, data identifiers, data element separators, data and message trailer characters).

Table 10 — Data Matrix ECC 200 alphanumeric data capacity

	"X" dimension				
Symbol size (with quiet zone)	**0,127 mm**	**0,150 mm**	**0,175 mm**	**0,200 mm**	**0,250 mm**
3 mm × 3 mm	43	25	10	6	3
4 mm × 4 mm	64	52	31	25	10
5 mm × 5 mm	127	64	64	43	25
6 mm × 6 mm	214	127	91	64	43
7 mm × 7 mm	304	214	127	91	64
10 mm × 10 mm	550	418	214	127	91
12 mm × 12 mm	862	550	418	304	214

4.4.3.1.4 Quiet zone

The Data Matrix ECC 200 symbol shall have minimum quiet zones of one X dimension width on all four sides of the symbol. Compliance with this International Standard does not require additional quiet zone beyond the minimum required by ISO/IEC 16022.

4.4.3.1.5 Error correction level

The data matrix symbol shall have an error-correction level of ECC 200 as defined in the ISO/IEC 16022.

4.4.3.1.6 Symbol quality

The Data Matrix ECC 200 symbol shall have a minimum symbol quality of 1,5/08/660/45, where the minimum overall symbol-grade is 1,5 (C), measured with an aperture size of 0,20 mm with a narrowband light source, at an angle of incidence of 45°.

Where a special application requires a smaller mark [X dimension smaller than 0,254 mm[1)]], it should have a minimum symbol quality of 1,5/05/660/45, where the minimum overall symbol-grade is 1,5 (C), measured with an aperture size of 0,125 mm with a narrowband light source, at an angle of incidence of 45°. Applications that incorporate small symbols shall measure all symbols with the 0,125 mm aperture. ISO/IEC 15415 provides additional guidance on selection of grading parameters in application specifications, in particular the relationship between aperture size and susceptibility to gaps and other defects.

When printing on label stock, the methodology for measuring the symbol quality shall be as specified in ISO/IEC 15415.

The minimally acceptable overall symbol-grade of 1,5 applies to the final symbol on the item at the point of receipt. It is recommended that the overall symbol-grade, at the point of printing the symbol, be equal to or exceed 2,5 to allow for process variations and possible degradation from packaging, storage, shipping, handling and use.

Guidance for placing direct marks on various substrates can be found in NASA-STD-6002, and NASA-HDBK-6003, ISO/IEC 24720 and SAE AS9132. AIM Global's Technical Symbology Committee (TSC) has created guidance in the AIM DPM-1, Direct Part Mark (DPM) Quality Guideline. Those striving to implement quality direct part-marking should follow its guidance.

If the intent is to read symbols through translucent packaging, the minimum overall symbol-grade shall be met when scanned through the packaging. This requirement is to ensure that the symbol can be read when scanned through protective packaging, such as an ESD container for circuit boards.

4.4.3.1.7 Encryption

Encryption shall not be used for mandatory data fields.

4.4.3.1.8 Character set

The character set shall be upper case alphabetic characters, numeric digits, and the eight characters [dash (–), period (.), space ( ), dollar sign ($), solidus (/), plus sign (+), asterisk (*) and percent sign (%)], as well as the recommended field separators, record separators, segment terminators and compliance indicator. A table of these characters and their hexadecimal and decimal equivalent is given in Annex C. The actual character set employed conforming to this International Standard shall be the character set permitted by the data field and not the symbology. It is recommended that the resultant data stream from scanning a data matrix symbol follow the syntax described in ISO/IEC 15434.

1) 0,254 mm = 10 mil.

4.4.3.2 MicroPDF417 symbol requirements

The MicroPDF417 symbols referenced in this document are defined in the ISO/IEC 24728, MicroPDF417 bar code symbology specification. See Figure 10.

Figure 10 — MicroPDF 417 symbol

4.4.3.2.1 "X" dimension

The appropriate X dimension for a symbol is determined by many factors including marking area available, surface type, environment and reading device(s) used. The user should implement their system using the largest X dimension that will enable the symbol to fit in the available area. The minimum open system X dimension shall be 0,127 mm. X dimension sizes below 0,25 mm should not be used because symbols with these small X dimensions cause a reduced depth of field and can be difficult to scan in an open-systems environment. Regardless of the element width, the symbol shall meet the print quality requirements of 4.4.3.2.5.

4.4.3.2.2 Element height

The MicroPDF417 symbol should have a bar height (height of the symbol element) two times the width of the narrow element (X dimension).

4.4.3.2.3 Quiet zone

MicroPDF417 symbols should have minimum quiet zones of one X dimension on all four sides of the symbol. Compliance with this International Standard does not require additional quiet zone beyond the minimum required by ISO/IEC 24728.

4.4.3.2.4 Error correction level

For MicroPDF417 symbols, error correction levels are automatically selected in accordance with ISO/IEC 24728.

4.4.3.2.5 Print quality

Two-dimensional symbols compliant with 4.4.3.2 shall have a minimum print quality of 1,5/05/660, where the minimum overall symbol-grade is 1,5 (C), measured with an aperture size of 0,127 mm, with a light source wavelength of (660 ± 10) nm. The methodology for measuring the print quality shall be as specified in ISO/IEC 15415 and ISO/IEC 24728.

The minimum acceptable overall symbol-grade of 1,5 applies to the final symbol on the item at the point of receipt. It is recommended that the overall symbol-grade, at the point of printing the symbol, be equal to or exceed 2,5 to allow for process variations and possible degradation from packaging, storage, shipping, and handling.

If the intent is to read symbols through translucent packaging, the minimum overall symbol-grade shall be met when scanned through the packaging. This requirement is to ensure that the symbol can be read when scanned through protective packaging, such as an ESD container for circuit boards.

4.4.3.2.6 Encryption

Encryption shall not be used for mandatory data fields.

4.4.3.2.7 Character set

The character set shall be upper case alphabetic characters, numeric digits, and the eight characters [dash (–), period (.), space ( ), dollar sign ($), solidus (/), plus sign(+), asterisk (*) and percent sign (%)], as well as the recommended field separators, record separators, segment terminators and compliance indicator. A table of these characters and their hexadecimal and decimal equivalent is given in Annex C.

4.4.3.3 QR Code symbol requirements

The QR code symbols referenced in this document are defined in ISO/IEC 18004.

Figure 11 — QR code symbol

4.4.3.3.1 "X" dimension

The appropriate X dimension for a symbol is determined by many factors including marking area available, surface type environment and reading device(s) used. The X dimension of a QR code symbol is equivalent to the cell size. It is recommended that the user implement their system using the largest X dimension that will enable the symbol to fit in the available area.

The minimum open system X dimension shall be 0,13 mm. X dimension sizes below 0,19 mm or greater than 0,38 mm are not recommended because these symbols may be difficult to scan in an open-systems environment. Regardless of the element width the symbol shall meet the symbol quality requirements of 4.4.3.3.6.

4.4.3.3.2 Element height ("Y" dimension)

The height of any individual cell of the QR code symbol should be equal to the X dimension.

4.4.3.3.3 Symbol size

The symbol size should not be greater than 12 mm by 12 mm. The reason for this requirement is to establish a known field of view for reading the label or mark.

The user should implement their system using largest X dimension that will enable the symbol to fit in the available area, up to the maximum dimensions shown in Table 11. This will allow for the best possible scanner performance. The particular symbol size that is printed will depend on the amount and type of data encode. The character count in Table 11 includes data overhead characters (specifically, message header, data identifiers, data element separators data and message trailer characters).

Table 11 — QR Code alphanumeric data capacity

"X" dimension						
Symbol size (with quiet zone)	Error correction level	**0,127 mm**	**0,150 mm**	**0,175 mm**	**0,200 mm**	**0,250 mm**
4 mm × 4 mm	M	20	N/A	N/A	N/A	N/A
	Q	16	N/A	N/A	N/A	N/A
	H	10	N/A	N/A	N/A	N/A
5 mm × 5 mm	M	61	38	20	N/A	N/A
	Q	47	29	16	N/A	N/A
	H	35	20	10	N/A	N/A
6 mm × 6 mm	M	122	61	38	20	N/A
	Q	87	47	29	16	N/A
	H	35	35	20	10	N/A
7 mm × 7 mm	M	178	122	90	61	N/A
	Q	125	87	67	47	N/A
	H	93	64	50	35	N/A
10 mm × 10 mm	M	483	311	221	154	61
	Q	352	221	157	108	47
	H	259	174	122	84	35
12 mm × 12 mm	M	734	528	366	262	122
	Q	531	376	259	87	87
	H	408	283	200	64	64

NOTE "N/A" indicates "not applicable".

4.4.3.3.4 Quiet zone

The QR code symbol shall have minimum quiet zone of four X dimension widths on all four sides of the symbol. Compliance with this International Standard does not require additional quiet zone beyond the minimum required by ISO/IEC 18004.

4.4.3.3.5 Error correction level

The error correction level shall be M (approximately 15 %), Q (approximately 25 %), or H (approximately 30 %) as specified in ISO/IEC 18004. The error correction level is determined by many factors including surface type environment, symbol quality, and reading device(s) used.

4.4.3.3.6 Symbol quality

The QR code symbol shall have a minimum symbol quality of 1,5/0.8/660/45, where the minimum overall symbol-grade is 1,5(c), measured with an aperture size of 0,20 mm with a narrowband light source, at an angle of incidence of 45°.

Where a special application requires a smaller mark (X dimension smaller than 0,254 mm), it should have a minimum symbol quality of 1,5/0.5/660/45, where the minimum overall symbol-grade is 1,5(c), measured with an aperture size of 0,125 mm with a narrowband light source, at an angle of incidence of 45°. Applications that incorporate small symbols shall measure all symbols with the 0,125 mm aperture. ISO/IEC 15415 provides

additional guidance on selection of grading parameters in application specifications, in particular the relationship between aperture size and susceptibility to gaps and other defects.

The methodology for measuring the symbol quality shall be as specified in ISO/IEC 15415, when printing on label stock.

The minimally acceptable overall symbol-grade of 1,5 applies to the final symbol on the item at the point of receipt. It is recommended that the overall symbol-grade, at the point of printing the symbol, be equal to or exceed 2,5 to allow for process variations and possible degradation from packaging storage, shipping, handling and use.

Guidance for placing direct marks on various substrates can be found in NASA-STD-6002, and NASA-HDBK-6003, ISO/IEC 24720 and SAE AS9132. AIM Global's Technical Symbology Committee (TSC) has created guidance in the AIM DPM-1, Direct Part Mark (DPM) Quality Guideline. Those striving to implement quality direct part marking should follow its guidance.

If the intent is to read symbols through translucent packaging, the minimum overall symbol-grade shall be met when scanned through the packaging. This requirement is to ensure that the symbol can be read when scanned through protective packaging, such as an ESD container for circuit boards.

4.4.3.3.7 Encryption

Encryption shall not be used for mandatory data fields.

4.4.3.3.8 Character set

The character set shall be upper case alphabetic characters, numeric digits, and the eight characters [dash (–), period (.), space ( ), dollar sign ($), solidus (/), plus sign(+), asterisk (*) and percent sign (%)], as well as the recommended field separators, record separators, segment terminators and compliance indicator. A table of these characters and their hexadecimal and decimal equivalent is given in Annex C. The actual character set employed conforming to this International Standard shall be the character set permitted by the data field and not the symbology. It is recommended that the resultant data stream from scanning a QR code symbol follow the syntax described in ISO/IEC 18004.

4.4.4 Composite symbol requirements

The composite symbols referenced in this International Standard are the GS1 Composite Symbols, as defined in ISO/IEC 24723, consisting of either a UPC-A, UPC-E, EAN-13, EAN-8, GS1-128, GTIN-14, GS1 Data Bar-14, GS1 Data Bar-14 Stacked, or GS1 Data Bar-14 Limited symbols as the composite linear component and a variant of MicroPDF417 (CC-A and CC-B) or PDF417 (CC-C) as the 2D composite component. The 2D composite component cannot be used by itself.

4.4.4.1 Composite symbols dimensions

The dimensions of composite symbols will be determined by a number of factors. The width of the symbol will be determined by the choice of linear symbology. The height of the symbol will be determined by the width of the chosen linear symbol and the amount and mix of the alpha and numeric data to be encoded. A wider linear symbol allows more data to be encoded in each row of the 2D Composite Component. For example, a GS1 Data Bar-14 Limited symbol is wider than a GS1 Data Bar-14 Stacked symbol. Numeric data can be encoded more efficiently than alphanumeric data and will result in a smaller symbol.

4.4.4.2 Cell size and "X" dimension

The minimum open system X dimension shall be 0,127 mm. X dimension sizes of 0,168 mm or greater are recommended because symbols with smaller X dimensions cause a reduced depth of field and may be difficult to scan in an open-systems environment. Regardless of the X dimension chosen, the symbol shall meet the print quality requirements of 4.4.4.5.

4.4.4.3 Symbol height

The linear components of composite symbols have a minimum symbol height defined in their respective symbology specifications. These minimum heights support all scanning technologies, including wand scanning and omni-directional point of sale scanning. For the applications supported by this International Standard, a height to width aspect ratio of 15 % will provide optimum performance and is recommended when space constraints permit.

The MicroPDF417 based composite components (e.g. CC-A and CC-B) shall have a minimum row height (height of the symbol element) of two times the width of the narrow element (X dimension). PDF417 based composite components shall have a minimum row height (height of the symbol element) of three times the width of the narrow element (X dimension).

4.4.4.4 Quiet zone

The linear components have a minimum quiet zone requirement defined in their respective symbology specifications.

CC-A and CC-B Composite Components have a minimum width requirement of one X dimension for the left and right quiet zone. CC-C composite components have a minimum width requirement of two times the X dimension for the left and right quiet zone. No quiet zone is required above or below a GS1 Composite Symbol.

4.4.4.5 Print quality

GS1 Composite Symbols shall have a minimum print quality of 1,5/06/660, where the minimum overall symbol-grade is 1,5 (C), measured with an aperture size of 0,150 mm, with a light source wavelength of (660 ± 10) nm. The methodology for measuring the print quality shall be as specified in the ISO/IEC 15416, and the applicable symbology specification.

The minimally acceptable overall symbol-grade of 1,5 applies to the final symbol on the item at the point of receipt. It is recommended that the overall symbol-grade, at the point of printing the symbol, be equal to or exceed 2,5 to allow for process variations and possible degradation from packaging, storage, shipping, and handling.

If the intent is to read symbols through translucent packaging, the minimum overall symbol-grade shall be met when scanned through the packaging. This requirement is to ensure that the symbol can be read when scanned through protective packaging, such as an ESD container for circuit boards.

4.4.4.6 Error correction level

CC-A and CC-B composite components shall incorporate the number of error correction codewords defined International Symbology Specification - GS1 Composite Symbols. CC-C composite components shall meet or exceed the minimum error correction level recommended in ISO/IEC 15438.

4.4.4.7 Encryption

Encryption shall not be used for mandatory data fields.

4.4.4.8 Character set

The character set shall be upper case alphabetic characters, numeric digits, and the six characters [dash (–), period (.), solidus (/), comma (,), space ( ), and asterisk (*)], as well as the recommended field separators, record separators, segment terminators and compliance indicator. A table of these characters and their hexadecimal and decimal equivalent is given in Annex C. It is recommended that the resultant data stream from scanning a GS1 Composite Symbol follow the syntax described in ISO/IEC 15434 and not that of GS1 128 emulation.

Annex A
(normative)

Label adhesive characteristics and mark durability

A.1 General

The following requirements and tests are intended to ensure that labels and marks can withstand extended long term exposure to a variety of indoor environments, which could include an assembly process, remain affixed to products and are scannable for the intended life of the product.

NOTE Additional tests could be required for specific exports to specific countries.

This International Standard covers the manufacturing and printing requirements for pressure sensitive adhesive-backed bar code labels intended primarily to automate product tracking, inventory control and serialized warranty systems. Labels being tested for conformance to A.3.4 and A.3.5 are intended to withstand harsh-environment exposures.

It is the responsibility of the trading partners to agree upon specifications of labels covered by this International Standard and to test the label in their operating environment prior to acceptance.

All labels shall be easily separable from the release liner without damage, be smudge-resistant and be reasonably flat. Label stock should be examined visually for evidence of particles of paper, dust, or other foreign material that would adversely affect print quality.

Observed or calculated values obtained from analysis, measurement, or test shall be rounded off in accordance with the rounding off method specified in ASTM E 29 to the nearest unit in the last right hand place of figures used in expressing the specified limit.

Where reference is made to an ASTM designation in this International Standard, the issue listed in the latest published ASTM index to standards shall apply unless otherwise specified.

Generation of voltage levels significant enough to cause ESD and damage to sensitive components can occur when using pressure sensitive labels. If meeting the requirements for ESD protected areas outlined in EIA-625 Requirements For Handling Electrostatic-Discharge-Sensitive (ESDS) Devices is required, using static control measures such as static dissipative labels or air ionization may be necessary.

A.2 Requirements

The labels shall be capable of meeting the requirements of this clause and 4.4, when tested in accordance with A.3.

Labels shall not show delamination within the label, blistered areas, or chipped edges. The bar code symbol and all alphanumeric characters printed on each label should be black on white substrate. Bar code labels shall be scannable and reasonably free from scratches, marks, voids, dots or misplaced colour. All labels should have minimum outside corner radii of 0,76 mm (approximately 0,03 inches) unless otherwise specified.

A.2.1 Label thickness

The maximum overall thickness of the label (not including the release liner) shall be 0,22 mm.

A.2.2 Nature of adhesive

The adhesive shall be pressure sensitive and permanent. It shall be applied in a uniform layer and be free from bubbles and foreign matter.

A.2.3 Adhesion strength

The minimum initial adhesion strength 2 h ± 10 min after application at ambient room temperature and humidity shall be 0,23 N/mm.

The minimum adhesion strength after stainless-steel test panel (ASTM D1000, Section 40.2) application and conditioning according to A.3.3, shall be 0,44 N/mm.

The labels shall show no evidence of delamination, bubbles, adhesive migration, or degraded image quality for either the text or the bar code symbol.

Although the test requirements specify stainless steel test panels, these adhesion tests should also be conducted using the target substrate to assure appropriate performance. Rough or textured surface may require increases in adhesive thickness, for example.

A.2.4 Label requirements after conditioning and printed circuit board processing

The labels shall meet the minimum print quality requirements of 4.4.2.5 after conditioning and passing through the printed circuit board processing cycles.

The minimum adhesion strength after test panel application and conditioning shall be 0,44 N/mm.

The labels shall show no evidence of delamination, bubbles, adhesive migration, or degraded image quality for either the text or the bar code symbol.

A.2.5 Abrasion

Labels or marks shall be capable of meeting the requirements of the appropriate subclauses in 4.4, after being subjected to the abrasion test in A.3.5.

A.3 Method of test

A.3.1 Label thickness

Conformance to the overall label thickness requirements shall use the ASTM D374, Method C, as referenced and modified in ASTM D1000. Measure the thickness of the label plus the release liner, the release liner alone, and obtain the label thickness by subtraction.

A.3.2 Nature of adhesive

The general nature of the adhesive shall be permanent, pressure sensitive and free from bubbles, voids, and foreign matter.

A.3.3 Adhesive strength

The determination of the adhesive strength of test labels consist of the proper test label size, panel preparation and panel conditioning for the appropriate application.

A.3.3.1 Test label size

A minimum label size of 10 mm by 25,4 mm should be used for adhesion measurements. When possible, it is recommended to use the actual label size intended for the application. Obtain a rubber-covered steel roller (ASTM D1000 Section 40.3) and prepare at least two stainless steel panels (ASTM D1000, Method A).

A.3.3.2 Label test panel preparation

Remove labels from the release liner and apply at least four labels to an ASTM stainless steel test panel, and roll according to ASTM D1000 Section 42 taking care to leave approximately 3 mm of release liner on each label for clamping purposes.

A.3.3.3 Initial adhesion strength

Remove at least three labels from the release liner, apply them to one or more stainless steel panels, and roll according to ASTM D1000 Section 42 taking care to leave approximately 3 mm of release liner on each label for clamping purposes. After 2 h ± 10 min, measure the adhesion strength to conform to the requirements of A.2.3 using a crosshead tensile tester making a 90° peel, as shown in Figure A.1, at a rate of 50 mm/min using a wire length of approximately 762 mm. Calculate the average value of adhesion.

A.3.3.4 Short term 100 °C – medium temperature test

Place the panel in an oven maintained at 100 °C. At the end of 168 h, remove the panel and allow it to cool to room temperature. Within 1 h to 3 h of removing the panel from the conditioning chamber, measure the bar code print quality of the labels on one panel in accordance with 4.4.2.5, or as appropriate, and the adhesion strength of the labels on the other panel in accordance with A.3.3.3 to determine conformance with the requirements of A.2.3. Determine the adhesion strength by measuring the adhesive strength of at least three test labels and averaging the results for the overall value. The labels shall show no evidence of self-lifting, delaminating, smudging, or discolouring after conditioning.

A.3.3.5 Short term 49 °C, 95 % RH – temperature and humidity test

Place the panel in an oven maintained at 49 °C and a controlled relative humidity (RH) of 95 % non-condensing. At the end of 96 h, remove the panel and allow it to cool to room temperature. Within 1 h to 3 h of removing the panel from the conditioning chamber, measure the bar code print quality of the labels on one panel in accordance with 4.4.2.5 or as appropriate and the adhesion strength of the labels on the other panel in accordance with A.3.3.3 to determine conformance with the requirements of A.2.3. Determine the adhesion strength by measuring the adhesive strength of at least three test labels and averaging the results for the overall value. The labels shall show no evidence of self-lifting, delaminating, smudging, or discolouring after conditioning.

A.3.3.6 Long term 82 °C – medium temperature test

Place the panels in a circulating-air oven at (82 ± 3) °C[2)]. After a period of 30 days, measure the bar code print quality of the labels on one panel in accordance with 4.4.2.5 or as appropriate and the adhesion strength of the labels on the other panel in accordance with A.3.3.3 to determine conformance with the requirements of A.2.3. Determine the adhesion strength by measuring the adhesive strength of at least three test labels and averaging the results for the overall value. The labels shall show no evidence of self-lifting, delaminating, smudging, or discolouring after conditioning.

A.3.3.7 Long term 32 °C, 95 % RH – temperature and humidity test

Place two panels of labels in a circulating-air oven at (32 ± 3) °C and (95 ± 2) % RH non-condensing. After a period of 30 days, measure the bar code print quality of the labels on one panel in accordance with 4.4.2.5, or

2) (82 ± 3) °C ≈ (180 ± 5) °F.

as appropriate, and the adhesion strength of the labels on the other panel in accordance with A.3.3.3 to determine conformance with the requirements of A.2.3. Determine the adhesion strength by measuring the adhesive strength of at least three test labels and averaging the results for the overall value. The labels shall show no evidence of self-lifting, delaminating, smudging, or discolouring after conditioning.

A.3.4 Additional label conditioning tests for labels or marks required to withstand printed circuit board processes

The tests described in the subclauses of A.3.4 represent a baseline to approximate the performance of pressure-sensitive labels in a variety of application processes. These tests are not intended to precisely duplicate the processes encountered in a manufacturing environment. To precisely predict the performance of the label it is recommended to test the process used in the intended manufacturing application.

A.3.4.1 Short term 260 °C – high temperature test for bottom-side labels for printed circuit boards

This test applies only to labels applied to the bottom side of printed circuit boards that are intended to withstand wavesolder processes. Place six labelled, printed ASTM D1000 test panels in an oven maintained at 260 °C. After seven minutes, remove the printed test panels and allow them to cool to room temperature. Within 1 h to 3 h, measure the bar code print quality of the labels in accordance with 4.4.2.5, or as appropriate. Determine the adhesion strength by measuring the adhesive strength of at least three test labels using a crosshead tensile tester making a 90° peel, as shown in Figure A.1, at a rate of 50 mm/minute using a wire length of approximately 762 mm. Calculate the average value of adhesion to determine conformance to the requirements specified in A.2.4. The labels shall show no evidence of self-lifting, delaminating, smudging, or discolouring after conditioning.

If the requirements of 4.4 are met, then subject one of the labelled test panels to the short term 100 °C test described in A.3.3.4 and the remaining labelled test panels to the short term 49 °C, 95 % RH test described in A.3.3.5. Determine conformance to the bar code print quality requirements of 4.4.2.5 or as appropriate and the adhesion requirements of A.2.4.

If the labels pass both short term tests then simultaneously subject a set of labelled test panels that has successfully gone through the short term 260 °C test to each of the long term tests described in A.3.3.6 and A.3.3.7. Determine conformance to the bar code print quality requirements of 4.4.2.5, or as appropriate, and the adhesion requirements of A.2.4.

A.3.4.2 Initial cleaning

Apply at least four labels to sample printed circuited boards. Subject the circuit board to an aqueous water cleaning process and then proceed to submit the labels to the infrared (IR) reflow test described in A.3.4.3. The substitution of other cleaners for the aqueous water cleaner may adversely affect the adhesive and/or bar code print quality of the labels. When such a substitution is necessary, the labels shall be inspected to meet the requirements of A.2.4 after the initial cleaning cycle.

A.3.4.3 IR reflow

Subject the labels to an IR reflow process test that meets the conditions in Table A.1. The temperatures in Table A.1 are the actual board temperatures.

Table A.1 — IR reflow conditions & temperatures

Conditions	Temperature	
	Degrees Celsius	Equivalent degrees Fahrenheit
Preheat temperature	150 ± 5	302 ± 8
Peak temperature	232 ± 2,5	450 ± 4,5
Maximum temperature rise rate	2 degrees per second	4 degrees per second
Time above 180 °C	(120 ± 5) s	

A.3.4.4 Post IR reflow cleaning

Within 1 h of completing the IR reflow test, subject the labels to an aqueous water cleaning process and proceed to subject the labels to the wavesolder test described in A.3.4.5. The substitution of other cleaners for the aqueous water cleaner may adversely affect the adhesive and/or bar code print quality of the labels. When such a substitution is necessary, the labels shall be inspected to meet the requirements of A.2.4 after the post IR reflow cleaning cycle.

A.3.4.5 Wavesolder

Subject the labels to a wavesolder process at the conditions indicated in Table A.2. Within 1 h of the completion of the wavesolder test, subject the labels to post wavesolder cleaning as described in A.3.4.6.

Table A.2 — Wavesolder conditions

Conditions	Temperature	
	Degrees Celsius	Equivalent degrees Fahrenheit
Preheat temperature	90	194
Maximum preheat temperature rise rate	2 degrees per second	4 degrees per second
Solder temperature	260	500
Conveyor angle	7 degree angle from the horizontal plane	
Process time	4 min to 9 min	

A.3.4.6 Post wavesolder cleaning

Subject the labels to an aqueous water cleaning process. The substitution of other cleaners for the aqueous water cleaner may adversely affect the adhesive and/or bar code print quality of the labels. When such a substitution is necessary, the labels shall be inspected to meet all the requirements of A.2.4, after the post wavesolder cleaning cycle.

A.3.4.7 Abrasion test

The Taber® abrader model 5135[3)] has been found to be a suitable apparatus for abrasion testing. When using this piece of equipment, the components needed for this abrasion procedure are:

— Specimen Holder E100-125;

— Specimen Plate S-16;

— Abrading Wheel CS-10.

The procedure is performed as follows.

a) The specimen plate shall be clean and dry. Two labels shall be attached to the specimen plate in such a position that the path of abrasion covers a maximum area of the bar code symbol. The labels shall not be trimmed; rather they are allowed to extend beyond the path of the abrasive wheel. The test labels shall be attached to the specimen plate in accordance with ASTM D1000, where applicable.

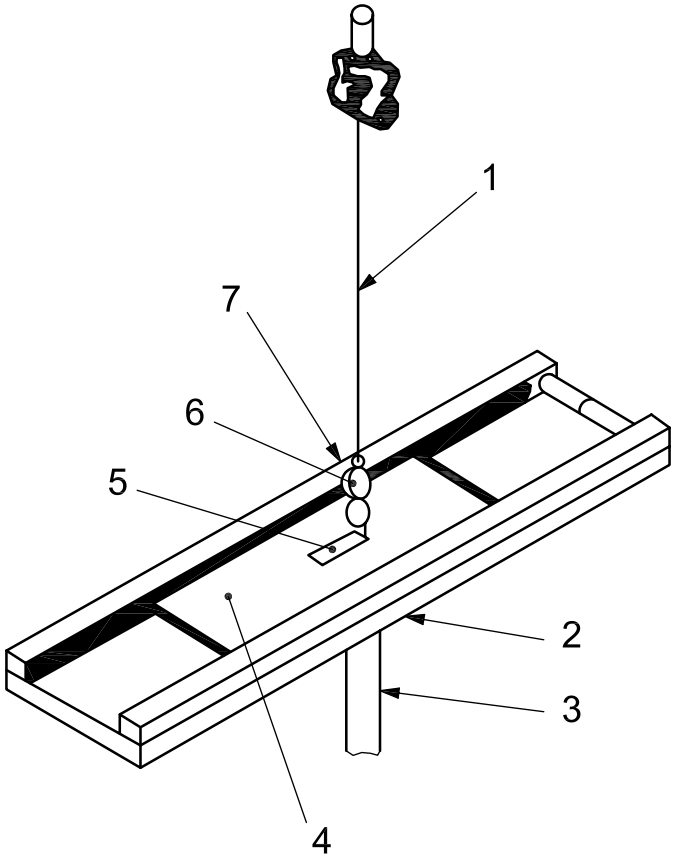
3) The Taber®Abraser (abrader) is the trade name of a product supplied by Taber Industries, New York, USA. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of the product named. Equivalent products may be used if they can be shown to lead to the same results.

b) When possible the test will be conducted in atmosphere controlled to 50 % RH and 21 °C to 23 °C. The test samples should be conditioned in the test atmosphere for at least 24 h before testing.

c) Select one character from the middle of the bar code symbol on each label and measure all the bars and spaces.

d) The specimen plate shall be rotated beneath the abrasion wheels for a period of (100 ± 1) cycles with a 250 g mass. After the required number of cycles, remove the specimen plate and examine the test character on each label.

e) Following the abrasion test, linear symbols must meet the print quality requirements of the applicable 4.4.2.5. Following the abrasion, test two-dimensional symbols must meet the print quality requirements of the applicable clause.



Key

1 wire
2 bed can be rotated
3 to testing machine
4 panel per ASTM D1000
5 label
6 clamp
7 bed with grooves to permit panel to slide freely

Figure A.1 — 90° peel test apparatus

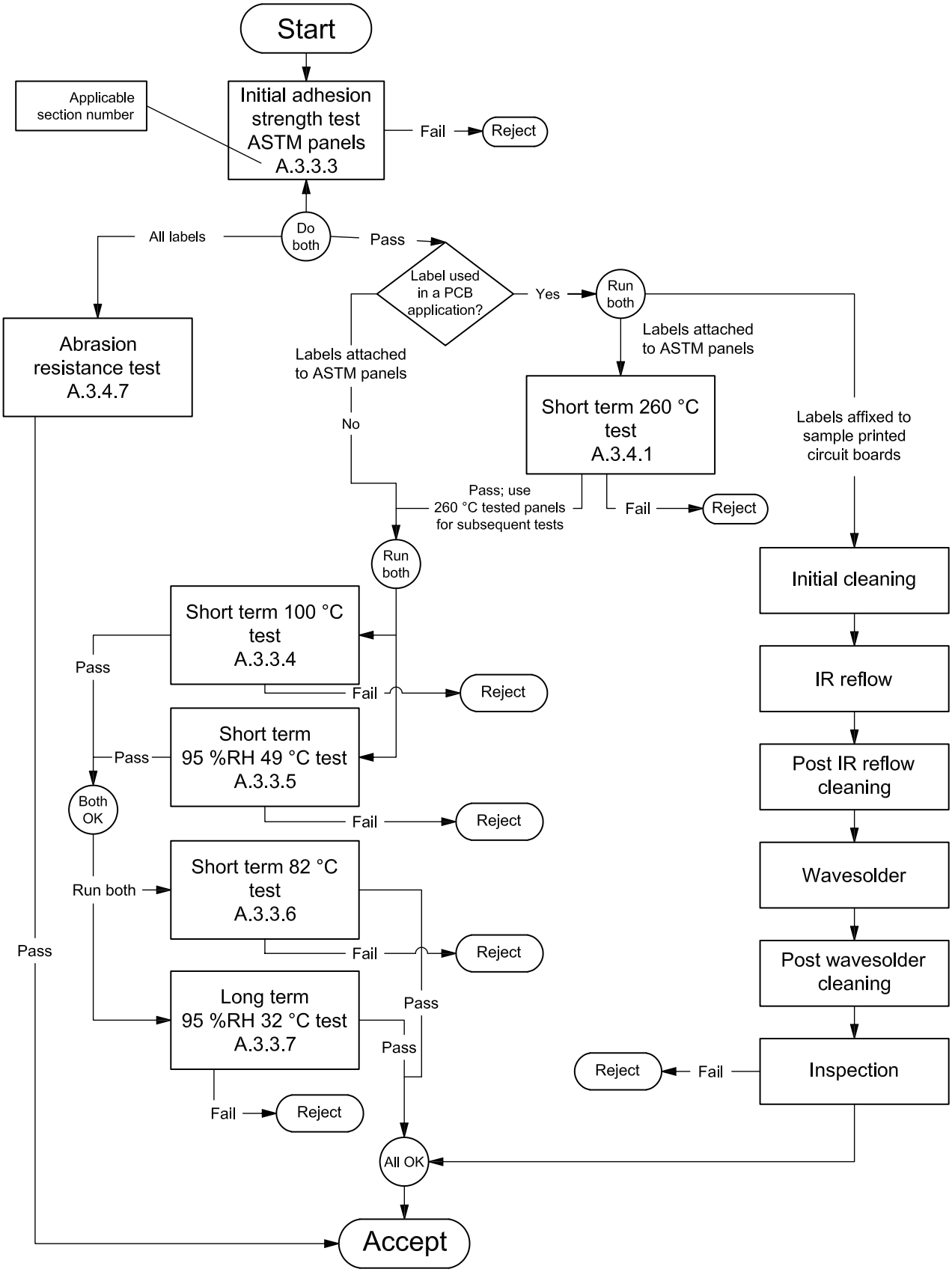


Figure A.2 — Flow chart

Annex B
(informative)

Partial list of commonly used identifiers

Data identifier	Identifier description	Application identifier
5D	ISO format YYMMDD immediately followed by an ANSI X12.3 Data Element Number 374 Qualifier providing a code specifying type of date (e.g. manufacture date “094”)	11 (Production date)
6D	ISO format YYYYMMDD immediately followed by an ANSI X12.3 Data Element Number 374 Qualifier providing a code specifying date type (e.g. manufacture date “094”)	906D
4L	Country of origin, two-character ISO 3166 country code	422 (3-digit ISO 3166 Code)
N	National/NATO Stock Number (NSN)	7001
P	Item identification code assigned by customer	241
1P	Item identification code assigned by supplier	01 - GTIN-14
2P	Code assigned to specify the revision level for an Item (e.g. engineering change level, edition, or revision)	240
3P	Combined manufacturer identification code/item code [12 digit U.P.C. data preceded by the digit zero (0)]	01 - GTIN-14
8P	14-digit GS1 format for Product Shipping Container Symbol code structure	01 - GTIN-14
9P	Combined DUNS®-9 supplier identification and item code assigned by the supplier	DI9P
11P	10-character (alphanumeric) CLEI Code for telecommunications equipment	DI11P
Q	Quantity, number of pieces, or amount (numeric only) (unit of measure and significance mutually defined)	30
7Q	Quantity, amount, or number of pieces in the format: quantity followed by the two character ANSI X12.3 Data Element Number 355 Unit of Measurement Code	
S	Serial number or code assigned by the supplier to an entity for its lifetime (e.g. computer serial number, traceability number, contract tool identification)	21
1S	Additional code assigned by the supplier to an entity for its lifetime (e.g. traceability number, computer serial number)	250
1T	Traceability number assigned by the supplier to identify/trace a unique group of entities (e.g. lot, batch, heat)	10
V	Supplier code assigned by customer	DIV
1V	Supplier code assigned by supplier	01 - GTIN-14
3V	Company code as assigned by the Uniform Code Council (UCC) or EAN international	95
12V	9-digit DUNS® number as assigned by Dun & Bradstreet to identify a manufacturer	DI12V
13V	9-digit DUNS® number as assigned by Dun & Bradstreet to identify a supplier	DI13V
17V	U.S. DoD CAGE Number	DI17V
18V	Identification of a party to a transaction in which the data format consists of two concatenated segments. The first segment is the unique code assigned to an issuing agency by NEN in accordance with ISO/IEC 15459, the second segment is a unique entity identification assigned in accordance with rules established by the issuing agency.	DI18V
20V	Identification of a party to a transaction as identified in 18V, followed by a plus (+) character followed by one or more code values from EDIFACT Code List 3035 “Party Qualifier”, separated by plus signs(+) [Never to be concatenated with other DIs in a linear symbol or other media where the concatenation character is a plus sign(+)]	DI20V

Annex C
(informative)

Subset of ASCII/ISO/IEC 646 (table of hexadecimal and decimal values)

HEX	DEC	ASCII / ISO 646	HEX	DEC	ASCII / ISO 646	HEX	DEC	ASCII / ISO 646
00	00	NUL	**30**	**48**	**0**	60	96	'
01	01	SOH	**31**	**49**	**1**	61	97	a
02	02	STX	**32**	**50**	**2**	62	98	b
03	03	ETX	**33**	**51**	**3**	63	99	c
04	**04**	**EOT**	**34**	**52**	**4**	64	100	d
05	05	ENQ	**35**	**53**	**5**	65	101	e
06	06	ACK	**36**	**54**	**6**	66	102	f
07	07	BEL	**37**	**55**	**7**	67	103	g
08	08	BS	**38**	**56**	**8**	68	104	h
09	09	HT	**39**	**57**	**9**	69	105	i
0A	10	LF	3A	58	:	6A	106	j
0B	11	VT	3B	59	;	6B	107	k
0C	12	FF	3C	60	<	6C	108	l
0D	13	CR	3D	61	=	6D	109	m
0E	14	SO	**3E**	**62**	**>**	6E	110	n
0F	15	SI	3F	63	?	6F	111	o
10	16	DLE	40	64	@	70	112	p
11	17	DC1	**41**	**65**	**A**	71	113	q
12	18	DC2	**42**	**66**	**B**	72	114	r
13	19	DC3	**43**	**67**	**C**	73	115	s
14	20	DC4	**44**	**68**	**D**	74	116	t
15	21	NAK	**45**	**69**	**E**	75	117	u
16	22	SYN	**46**	**70**	**F**	76	118	v
17	23	ETB	**47**	**71**	**G**	77	119	w
18	24	CAN	**48**	**72**	**H**	78	120	x
19	25	EM	**49**	**73**	**I**	79	121	y
1A	26	SUB	**4A**	**74**	**J**	7A	122	z
1B	27	ESC	**4B**	**75**	**K**	7B	123	{
1C	**28**	**FS**	**4C**	**76**	**L**	7C	124	|
1D	**29**	**GS**	**4D**	**77**	**M**	7D	125	}
1E	**30**	**RS**	**4E**	**78**	**N**	7E	126	~
1F	**31**	**US**	**4F**	**79**	**O**	7F	127	DEL
20	**32**	**SP**	**50**	**80**	**P**			
21	33	!	**51**	**81**	**Q**			
22	34	"	**52**	**82**	**R**			
23	35	#	**53**	**83**	**S**			
24	**36**	**$**	**54**	**84**	**T**			
25	**37**	**%**	**55**	**85**	**U**			
26	38	&	**56**	**86**	**V**			
27	39	'	**57**	**87**	**W**			
28	40	(	**58**	**88**	**X**			
29	**41**	**)**	**59**	**89**	**Y**			
2A	**42**	*****	**5A**	**90**	**Z**			
2B	**43**	**+**	**5B**	**91**	**[**			
2C	44	,	5C	92	\			
2D	**45**	**-**	5D	93	]			
2E	**46**	**.**	5E	94	^			
2F	**47**	**/**	5F	95	_			

Values shown in **BOLD** are specifically supported by this International Standard.

Annex D
(informative)

User guidance for implementation of the ISO 15434 data syntax

ISO 15434 employs as a header, the three-character sequence [)>. ISO 15434 further employs the following special characters as separators and terminators: <GS>, <FS>, <RS>, <US>, and <EOT>. These characters may be difficult to implement without specific knowledge of the programming language and character sets employed.

Information and guidance on the use of ISO 15434 special characters can be found by contacting specific printer or software manufacturers or by referring to bibliography item [20].

Annex E
(informative)

Data format for UPC-A (UCC-12), EAN-13 and GS1-128 symbols

One set of formats recommended within this International Standard is that of GS1 Global Trade Item Number (GTIN). UPC-A and UPC-E are 12-digit codes. EAN-13 is a 13-digit code. Coding for levels of packaging above an individual item is referred to as the 14-digit GTIN-14. This coding structure provides for international article uniqueness at all packaging levels. An example of this uniqueness is shown in Table E-1. In both examples, all three codes are logically equivalent. If read into a database as a numeric 14-digit field, the data would be right-hand justified, zero-filled to the left. Read into such a numeric field each structure is now identical. Note: On 1 January 2005, U.S. users began to process the EAN-13 and EAN-8 symbols in addition to the UPC-A and UPC-E symbols at the point of sale. At the same time, it is recommended that databases be updated to allow for the full 14-digit representation of the GTIN. Please refer to the latest GS 1 General Specifications for additional information.

Table E.1 — GS1 coding conventions

Data Structures	GTIN Format [a]													
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_8	T_{10}	T_{11}	T_{12}	T_{13}	T_{14}
GTIN-14	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	N_{11}	N_{12}	N_{13}	N_{14}
GTIN-13	0	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	N_{11}	N_{12}	N_{13}
GTIN-12	0	0	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8	N_9	N_{10}	N_{11}	N_{12}
GTIN-8	0	0	0	0	0	0	N_1	N_2	N_3	N_4	N_5	N_6	N_7	N_8

[a] T represents the position of each individual digit in a computer file format, N represents the position of each individual digit in a given data structure, and 0 represents a filler digit.

As shown in Table E.1, GS1 coding structures are able to provide for article uniqueness across the supply chain. The United States initially developed UPC-A as a 12-digit code. The symbol is constructed from 30 bars and 29 intervening spaces (Figure E.1) where each character is comprised of 2 bars and 2 spaces over seven modules (Figure E.2). The symbol uses odd-parity (Table E.2, Number set A) for the left side of the symbol and even parity (Table E.2, Number set C) for the right side of the symbol. One of the original purposes for different parity patterns on left and right sides of the symbol was to enable scanners to be able to read the left side with one scanning path, the right side with another scanning path, and to enable the decoding software to reassemble the entire coded message.

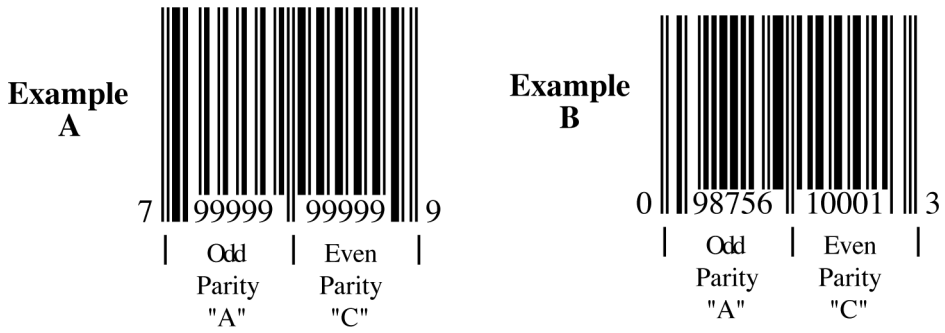


Figure E.1 — UPC-A parity

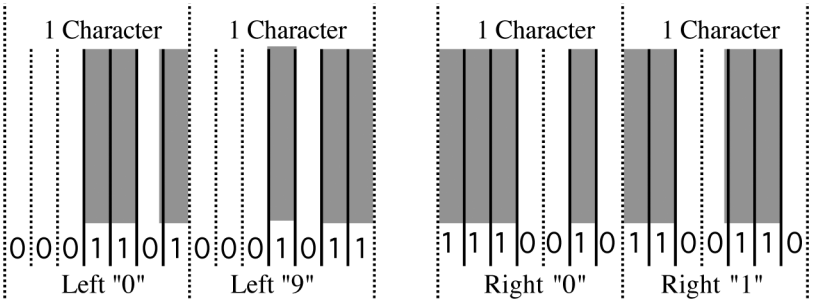


Figure E.2 — GS1 character structure (7 modules – 2 bars & 2 spaces)

Table E.2 — GS1 character parity assignments

Character value	Number set A	Number set B	Number set C
0	0001101	0100111	1110010
1	0011001	0110011	1100110
2	0010011	0011011	1101100
3	0111101	0100001	1000010
4	0100011	0011101	1011100
5	0110001	0111001	1001110
6	0101111	0000101	1010000
7	0111011	0010001	1000100
8	0110111	0001001	1001000
9	0001011	0010111	1110100

The GS1 Prefix (Table E.3) is a number with two or more digits, administered by the GS1 Global Office that denotes the format and meaning of a particular Element String. The main purpose of the GS1 Prefix is to allow decentralisation of the administration of identification numbers.

The GS1 Prefix and the Company Number jointly form the GS1 Company Prefix, which is assigned to each system user by a GS1 Member Organisation. The resulting GS1 Company Prefix is globally unique within the GS1 System. Since 2002, the Company Number assigned by the GS1 US (formerly known as UCC), is no longer fixed at 5 digits in length, it varies in length.

GS1 Company Prefixes are assigned to entities that administer the allocation of the GS1 System identification numbers. These entities may be, for example, commercial companies, non-profit organisations, governmental agencies, and business units within organisations. The criteria to qualify for the assignment of a GS1 Company Prefix are established by the GS1 Member Organisations.

Table E.3 — GS1 prefixes

GS1 Prefixes	Significance
000 - 019	UCC™ data structure[a]
02	GS1 Variable Measure Trade Item identification for restricted distribution
030 - 039	UCC data structure
04	GS1 item numbering for restricted distribution within a company
05	GS1 US coupon identification
060 - 099	UCC data structure
100 - 139	GS1 data structure
140 - 199	Reserve
20 - 29	GS1 numbering for restricted distribution within a geographic region
300 - 969	GS1 data structure
970 - 976	Reserve
977	ISSN standard numbering (serial publications)
978	ISBN standard numbering (books)
979	ISBN or ISMN standard numbering
980	GS1 identification of Refund Receipts
981-982	GS1 coupon identification for common currency areas
983 - 989	Reserved for further GS1 coupon identification
99	GS1 coupon identification
NOTE These prefixes all assume an EAN/UCC-13 Data Structure. When UCC-12 (UPC) carries UCC identification numbers bar code symbols, the prefixes 00 to 09 will appear as the single figures 0 to 9.	
[a] Starting from GS1 Company Prefix 00 00100 to avoid collision with EAN/UCC-8 Identification Numbers.	

The design of UPC-A in the U.S. led to the desire to have a single system worldwide, though a concern developed that there was insufficient capacity in this 12-digit number to support worldwide numbering. A method was developed to expand the 12-digit code to a 13-digit code through the creation of another number set (Table E.2, Number set B) and deriving the 13th digit through individual character parity of the left side of the symbol. The left-hand side of a UPC-A/EAN-13 symbol encodes six 2 bar / 2 space / over 7 modules characters. Both UPC-A and EAN-13 have 30 bars and 29 intervening spaces. Table E.4 shows the technique employed by GS1 to derive the 13th digit in EAN-13.

Table E.4 — T GS1 character 13 value assignments

Value of 13th digit	Parity number sets of digits 12 to 7					
	12	11	10	9	8	7
0	A	A	A	A	A	A
1	A	A	B	A	B	B
2	A	A	B	B	A	B
3	A	A	B	B	B	A
4	A	B	A	A	B	B
5	A	B	B	A	A	B
6	A	B	B	B	A	A
7	A	B	A	B	A	B
8	A	B	A	B	B	A
9	A	B	B	A	B	A

As can be seen from Table E.5, when all characters are composed within number set A (as is the case in UPC-A), the 13th digit derived for UPC-A is a zero “0”. Therefore, the GS1 Prefix could be interpreted as “00” to “09” instead of “0” to “9”. Such a method makes UPC-A a 13-digit code, fully compatible with GS1 systems.

Table E.5 — Example of UPC parity structures for GS1 scanning

Character Position	13	12	11	10	9	8	7	6	5	4	3	2	1
Parity Number Set		A	A	A	A	A	A	C	C	C	C	C	C
Character (Example #A)	0	7	9	9	9	9	9	9	9	9	9	9	
Character (Example #B)	0	0	9	8	7	5	6	1	0	0	0	1	3

NOTE
Character position 1 is the Modulus 10 check digit.
Character positions 2 to 6 are the manufacturer assigned item code
Character positions 7 to 11 are the GS1 Company Prefix Number
Character position 12 is the UPC Number System Character
Character position 13 is the filled "0" value of a 12-digit code in a 13-digit field

Table E.6 shows how the 13th digit could be developed for both a U.S. and a French company.

Table E.6 — Example of EAN parity structures

Character Position	13	12	11	10	9	8	7	6	5	4	3	2	1
Parity Number Set		A	A	B	B	B	A	C	C	C	C	C	C
Character	3	0	9	8	7	5	6	1	0	0	0	1	0

NOTE
Character position 1 is the Modulus 10 check digit.
Character positions 2 though 11 are the GS1 Member Organization Assigned Company Code and Item Code.
Character position 13 is the derived 13th digit (See Table E-4).

Having developed a way to expand a 12-digit symbol into a 13-digit symbol, EAN International (now known as GS1) set upon a course to assign unique prefixes to each of their numbering organizations. These prefixes are sometimes referred to as country codes. Today there are 96 member organizations, representing over 100 different countries, including the United States. Table E.7 shows a partial list of these GS1 Member Organizations.

Table E.7 — Partial list of GS1 Member Organization codes

	Position 14	Position 13	Position 12	Position 11	Position 10	Position 9	Position 8	Position 7	Position 6	Position 5	Position 4	Position 3	Position 2	Check Digit
U.S. / Canada	0	**0**	**0-9**	N	N	N	N	N	N	N	N	N	N	N
France	0	**3**	**0-7**	N	N	N	N	N	N	N	N	N	N	N
Germany	0	**4**	**0-3**	N	N	N	N	N	N	N	N	N	N	N
Taiwan	0	**4**	**7**	**1**	N	N	N	N	N	N	N	N	N	N
Hong Kong	0	**4**	**8**	**9**	N	N	N	N	N	N	N	N	N	N
U.K. / Ireland	0	**5**	**0**	N	N	N	N	N	N	N	N	N	N	N
Greece	0	**5**	**2**	**0**	N	N	N	N	N	N	N	N	N	N
South Africa	0	**6**	**0**	**0-1**	N	N	N	N	N	N	N	N	N	N
Mexico	0	**7**	**5**	**0**	N	N	N	N	N	N	N	N	N	N
Sweden	0	**7**	**3**	N	N	N	N	N	N	N	N	N	N	N
Singapore	0	**8**	**8**	**8**	N	N	N	N	N	N	N	N	N	N
Australia	0	**9**	**3**	N	N	N	N	N	N	N	N	N	N	N
Malaysia	0	**9**	**5**	**5**	N	N	N	N	N	N	N	N	N	N
Bookland [a]	0	**9**	**7-8**	**8**	N	N	N	N	N	N	N	N	N	N

[a] Bookland is a synonym for authorities listed with prefixes 977 to 979

It should be noted that these “country codes” are not the same thing as “country of origin”. For example, the GS1 US could assign a manufacturer identification code (company prefix) for a non-U.S. manufacturer, e.g. located in Canada. Also a German manufacturer can receive a GS1 US company code. Over the past 10 years some non-U.S. manufacturers were compelled to secure UCC company codes so that U.S. retailers could read the manufacturer’s article number into their 12-digit databases.

It should be further noted that while some member organizations have two digit codes, other countries have three digit codes. Member organizations / countries which have a large number of manufacturers may have two digits, while member organizations / countries with a smaller number of manufacturers may have three. Also, some member organizations / countries have a range of two or three digit codes, e.g. the U.S. / Canada has “00” to “09”, France has “30” to “37”, South Africa has “600” to “601”, Bookland has “978” to “979”, and so on.

Annex F
(informative)

For applications using Code 39 and Code 128 symbologies

F.1 General

Open systems, such as identified in this International Standard, encourage the free movement of products between any supplier and customer. Organizations scanning the bar code label for shipping and receiving may be presented with symbols which do not conform to their specific requirements but are useful elsewhere in the supply chain. This annex addresses issues that are associated with this situation. These issues can affect any organization. This annex also addresses the issues that need to be considered in a planned migration between options.

This annex describes the use of symbology identifiers as identified in ISO/IEC 15424. The Symbology identifier is a prefix to the data transmitted by a decoder. Symbology identifiers are not encoded in the symbol.

The options, as defined in this annex are:

- Option 1
  - AIs with GS1-128 symbology,
  - AIs with another symbology or data carrier;
- Option 2 – DIs with Code 39 symbology;
- Option 3
  - DIs with Code 128 symbology,
  - DIs with another symbology or data carrier.

Although it may be intended that only one of these combinations be in a system, it is important for all users to be aware that any of the other combinations can appear in a scanning system. Given this fact, organizations may choose to support a single option or support other options as well. These are discussed below.

F.2 Systems where a single option is intended to be read

For users selecting to operate in a single option environment there are three procedures to consider.

1) For single use of option 1 users may be able to switch off all other symbologies in a decoder, including Code 128, as described in option 3. If the decoder supports symbology identifiers the host system shall validate the appropriate symbology identifier, specifically **]C1** that signifies a GS1-128 symbol having a FNC1 character in the first position after the start code.

2) For single use of option 2 users shall switch off all other symbologies in any decoder. If the decoder supports symbology identifiers the host computer system shall validate the appropriate symbology identifier, specifically **]A0**.

3) For single use of option 3, users will need to fully implement the symbology identifier capability. For decoders that do not support symbology identifiers, host computer systems will be unable to automatically

distinguish between option 1 and option 3. By using the symbology identifier, the host computer can distinguish between the different options and filter out the unwanted options. The host computer system shall validate the appropriate symbology identifier, specifically **]C0**.

F.3 Systems where multiple options are intended to be read

Users, who choose to provide their systems with information scanned from labels using two or all of the options, shall fully implement Symbology Identifier capabilities. For decoders that do not support Symbology Identifiers, host computer systems will be unable to automatically distinguish between option 1, option 2, and option 3. By using the Symbology Identifier, the host computer can distinguish between the different options and filter out the unwanted options. The combination of the symbology identifier and the ASC MH10 Data Identifier or Application Identifier will provide the user with reliable input. Users should consider adopting additional reliability features described in F.3.3 as appropriate.

F.4 Migration choices

It is feasible to migrate from one option to another. The realistic migrations are:

— Code 39 using ASC MH10 DIs to GS1-128 using AIs;

— Code 39 using ASC MH10 DIs to Code 128 using ASC MH10 DIs;

— A linear bar code symbology using ASC MH10 DIs to another data carrier;

— Code 128 using ASC MH10 DIs to GS1-128 using AIs;

— A linear bar code symbology using GS1 AIs to another data carrier.

Migration paths require some (usually considerable) period of parallel operation. This has implications for both systems (see F.4.1) and equipment (see F.4.2).

F.4.1 Systems considerations

Industry bodies and individual suppliers migrating between any two options need to be aware of their responsibilities to customers. While it is relatively easy for a company or industry body to assume that its bar code label standards affect all customers equally, this is an over-simplification.

If there is a change between ASC MH10 DIs and GS1 AIs (for example migration choices from DIs to AIs) the computer systems supporting label production and customers' computer systems need to be upgraded to handle GS1 Application Identifiers prior to any switch.

Each of the migration choices requires the host computer system software to be able to recognize Symbology Identifiers (see F.4.2.2), which provide the only reliable means of distinguishing between the symbologies and some of their optional features.

Such migrations involve significant changes that need to be mutually agreed to by supplier and customer groups. Failure to do so could result in problems with well-established systems and even to the corruption of data.

F.4.2 Equipment considerations

F.4.2.1 Printing considerations

Printing hardware, printing software, and users implementing printing hardware and software must be capable of producing the new format symbols by including the ASC MH10 Data Identifiers and GS1 Application Identifiers correctly and generating the correct symbol.

F.4.2.2 Decoder considerations

In order to avoid errors in automatic data capture, bar code readers that can automatically read more than one symbology should be configured to read only those symbologies and technologies required by the application.

Decoders need to be configured to read and transmit data from both the old and new symbology and to transmit the relevant symbology identifier.

NOTE Migration from DIs to AIs requires a different decoder setting between the old and new standards.

Not all decoders are capable of transmitting symbology identifiers. The use of non-conforming equipment in a system with the old and new symbologies could result in the inability to correctly distinguish between them. Some decoders may be upgradeable; others may not be upgradeable and will need to be replaced.

Scanners are unlikely to be affected. Models that have integrated decoders may be affected.

F.4.3 Recommended actions to manage migration

F.4.3.1 By the responsible industry body

The industry body responsible for initiating the migration needs to identify any potential transition problems likely to be experienced by suppliers and customers. Liaison should take place with bodies representing interests as soon as the supplying industry is contemplating a migration. In particular, it should

— identify and carefully consider the migration issues,

— survey suppliers and customers to assess the extent that equipment will be made obsolete,

— survey these groups to assess the extent that databases will need to be upgraded, and

— allow for an upgrade path for the enhancement of equipment and computer systems, bearing in mind that users required to scan symbols consistent with the new standard need to have systems in place before the new label formats are introduced.

NOTE This is a completely different implementation strategy to that commonly adopted when initially implementing bar code systems, where a number of labels usually precede the implementation of scanning.

F.4.3.2 By those organizations producing the label

Suppliers implementing a change of identifier standard and/or symbology should:

— If changing to GS1 AIs, ensure that the mapping software between the internal database and the Application Identifiers is correct.

  NOTE The format of data can be different between ASC MH10 DIs and GS1 AIs for the nominal data, for example, the way dates or units of measure are encoded.

— If changing to GS1-128, ensure that printing software and/or hardware fully supports the options in that symbology, including FNC1 in the first position after the start code and in other positions.

— Carry out print quality tests of Code 128 and GS1-128 prior to a live launch of the new format label.

These systems tests could identify the need to upgrade or replace existing systems and hardware.

F.4.3.3 By those organizations scanning the label

Organizations needing to scan the new format label should take the following actions prior to the live introduction of the label.

— Ensure that decoders are fully compliant with the applicable ISO/IEC 15424 Symbology Identifier specification with respect to Code 39, Code 128, or the symbology/technology employed.

— Implement software that checks on the validity of both ASC MH10 Data Identifiers and GS1 Application Identifiers.

— Implement software that parses the data for format and length.

— If changing to GS1 AIs, implement software to convert the data from the AI format to the format requirements of the host computer.

NOTE This is required because the format of some data fields is different between ASC MH10 DIs and GS1 AIs.

Annex G
(informative)

Using DUNS®, with ASC MH10 Data Identifiers (DIs) in linear bar code and two-dimensional symbols

G.1 About the DUNS® Number

The DUNS® number is a non-indicative nine-digit number assigned by Dun & Bradstreet to identify unique business entities. It is also used to access and link global business data. The DUNS® Number can "not only identify the company", but can "also identify the exact location of that company's plant" that actually manufactured the product. The first eight digits of the DUNS® are sequentially machine generated. The ninth digit is a check digit that is mathematically related to the other digits. Once a DUNS® Number is assigned, it will not be reused or be reissued to another company.

There are approximately 45 million DUNS® Numbers already issued. To ensure an adequate supply of DUNS® Numbers for the future, Dun & Bradstreet has implemented an alternate check digit calculation, which provides an additional 100 million DUNS® Numbers.

The DUNS® Number can be used by itself in a separate bar code symbol, or as a separate field in a 2D symbol. The DUNS® Number can also be combined with a product number in one bar code symbol, or in one data field in a 2D symbol. Whatever the type of machine-readable code used, linear bar code or 2D, the appropriate ASC MH10 DI(s) must precede them.

There is no charge to receive a DUNS® Number for your business.

G.2 Using the DUNS® Number in bar codes

See Figure G.1 for an example using Code 39 or Code 128 to identify the manufacturer in one bar code and the product number in another bar code.

(12V) = ASC MH10 'DI' immediately followed by (043325711) = 9-digit DUNS® Number

(1P) = ASC MH10 'DI' immediately followed by (MH80312) = Manufacturer's Product Number

Figure G.1 — Example using DUNS® Number in bar codes

See Figure G.2 for an example using Code 39 or Code 128 to identify the manufacturer & the product number in one combined bar code symbol.

(9P) = ASC MH10 ‘DI’ immediately followed by the 9-digit DUNS® (043325711) plus the manufacturer's Product Number (MH80312)

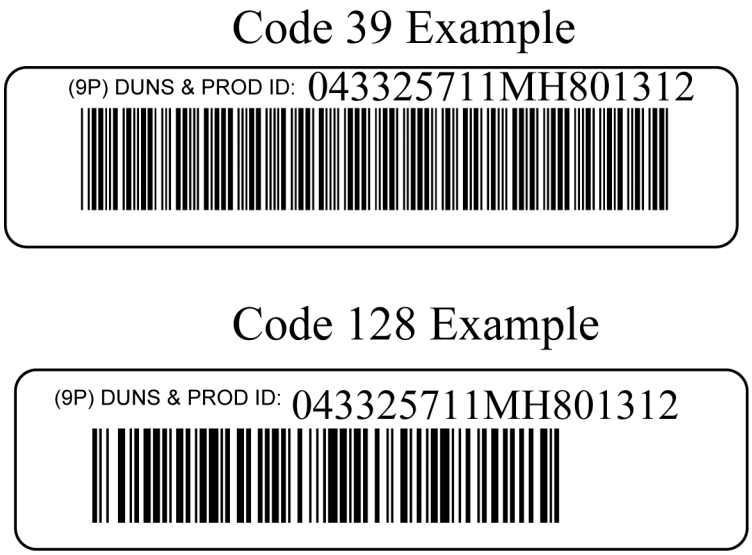


Figure G.2 — Example using DUNS® Number combined with product identification in bar codes

G.3 Using the DUNS® Number in 2D symbols

Figure G.3 shows a label including a data matrix symbol encoding DUNS® and product ID, “traceability number” (e.g. serial number, lot/batch number, manufacture date), and country of origin.

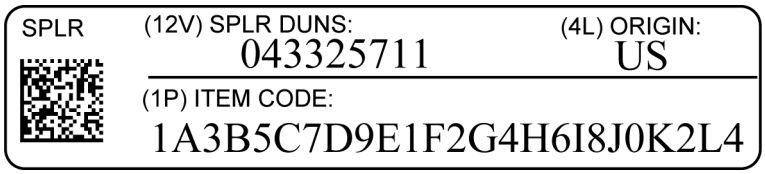


Figure G.3 — Example using DUNS® Number in 2D symbols

Annex H
(informative)

Register of issuing agency codes (IACs) for ISO/IEC 15459

H.1 Managing uniqueness of supply chain parties

Unique identification can occur at many different levels in the supply chain, at the transport unit, at the item level, and elsewhere. Several parties — the sender, the receiver, one or more carriers, customs authorities, etc. — often handle such distinct entities. Each of these parties needs to be able to identify and trace the item so that reference can be made to associated information such as address, order number, contents of the item, weight, sender, batch or lot number. There are considerable benefits if the identity of the item is common between all the relevant parties.

The procedures and obligations to construct a unique identifier for item management are defined in ISO/IEC 15459-2. It specifies the procedural requirements to maintain a non-significant, unique identifier for item management applications and outlines the obligations of the registration authority and issuing agencies.

H.2 ISO/IEC 15459-2 registration authority

The ISO/IEC 15459-2 registration authority is Nederlands Normalisatie-instituut (NEN) who maintains the 15459 IAC Register. For the current register, consult the bibliography [21]. At the time of publication of this document the following were registered issuing agencies under ISO/IEC 15459-2.

Table H.1 — ISO/IEC 15459-2 issuing agencies

CEPI Confederation of European Paper Industries	PA	CEPI 250 Avenue Louise 1050 BRUSSELS BELGIUM
CEFIC European Chemical Industry Council	QC	CEFIC Avenue E.van Nieuwenhuysen 4-1 1160 BRUSSELS BELGIUM
DHL Freight GmbH	ND	DHL Freight GmbH Kennedydamm 15 40476 DUSSELDORF GERMANY
DOD-DLIS Department of Defense - Defence Logistics Information Service	LD	Defence Logistics Information Service 74 Washington Ave N. STE 7 BATTLE CREEK, MI 49017-3084 USA
Dun & Bradstreet	UN	Dun & Bradstreet 3 Sylvan Way PARSIPPANY NJ 07054 USA
GS1 (European Article Numbering Association)	0 thru 9	GS1 Blue Tower Avenue Louise 326, bte 10 1050 BRUSSELS BELGIUM

ECRI	VEC	ECRI 5200 Butler Pike Plymouth Meeting PA 19462-1298 USA
EDIFICE Electronic Data Interchange for Companies with Interest in Computing and Electronics	LE	EDIFICE Rue du Rhône, 100 1204 GENEVA SWITZERLAND
EHIBCC European Health Industry Business Communications Council	LH	EHIBCC 100-102 Rue Theodore Decuyper 1200 WOLUWE St. LAMBERT BELGIUM
EUROFER European Confederation of Iron and Steel Industries	ST	EUROFER Rue du Noyer, 211 B-1000 BRUSSELS BELGIUM
EuroExpress Verein EuroExpress	UT	Verein EuroExpress 20, Place des Halles 67000 STRASBOURG FRANCE
FIATA International Federation of Freight Forwarders Associations	LF	FIATA Baumackerstrasse 24, 8050 ZURICH SWITZERLAND
G.T.F. Group of Terrestrial Freight Forwarders	VGT	GTF 33 rue Galilée 75116 PARIS FRANCE
IBM International Business Machines	VIB	IBM Tour Descartes 92066 PARIS LA DEFENSE CEDEX FRANCE
JIPDEC/CII Japan Information processing Development Corporation/Electronic Commerce Promotion Center	LA	JIPDEC/CII 3-5-8 Shibakoen, Minato-ku TOKYO JAPAN
NATO AC/135	D	NATO AC/135 2 Rue de La Gare 8302 CAPELLEN LUXEMBOURG
NorStella	KNO	NorStella Foundation for E-business and Trade procedures Postbox 2526 Solli N-0202 OSLO NORWAY
ODETTE EUROPE	OD	Odette Europe Forbes House Halkin Street LONDON SW1X 7DS UNITED KINGDOM
TPG POST	NL	TPG POST Prinses Beatrixlaan 23 2595 AK 's-GRAVENHAGE THE NETHERLANDS

SIEMENS	SI	Siemens AG 80286 MUNICH GERMANY
Telcordia Technologies, Inc.	LB	Telcordia Technologies, Inc. 45 Knightsbridge Road Room PY5 5D-219 PISCATAWAY, NJ 08854-3923 USA
Teikoku Databank Ltd.	VTD	Teikoku Databank Ltd 2-5-20 Minami Aoyama Minatoku Tokyo JAPAN
Universal Postal Union	J	Universal Postal Union Case Postale 3000 BERNE 15 SWITZERLAND
van Gend & Loos	VGL	van Gend & Loos Odijkerweg 19 3972 NE DRIEBERGEN-RYSENBURG THE NETHERLANDS
Xifrat Daten A.G.	RG	Xifrat Daten A.G. Alpenstrasse 15 6304 ZUG SWITZERLAND

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