



GSMP:

General Specifications Change Notification (GSCN)

| GSCN # | GSCN Name | Effective Date |
|--------|---------------|----------------|
| 16-477 | FNC1 vs. <GS> | 20-Dec-2016 |

Associated Work Request (WR) Number:

WR 16-477

Background:

The GS1 General Specifications have always stated that the Function 1 Symbol Character (FNC1) must be used as the data separator in all GS1 barcodes that use the GS1 AI standards.

As FNC1 has no ASCII value, when it is used as a separator character it is transmitted as <GS> (ASCII value 29). This has meant that some people, working backwards from the transmitted data, have used <GS> as the separator character and not FNC1. This is presently an error, but it makes no difference to the transmitted data when the barcode is scanned.

It is also simply not possible to use a FNC1 with GS1 QR Code, as it is not part of the encodable character set.

[The FNC1 Symbol Character is one of the four Function Characters in Code 128, but they have no ASCII equivalent and are not intended to be transmitted. When the double start pattern for GS1-128 is used, the combination of Start A, B, or C and FNC1 is transmitted as the symbology identifier. When FNC1 is used as a data separator, there is no direct translation for it into ASCII, so the value <GS> must be used instead.]

If <GS> were allowed as a data separator, the scanners would not know the difference. Using FNC1 in GS1-128 is more space efficient than using <GS>, because using <GS> will often require a change in character set, and two extra symbol characters might be needed to handle this. However if the barcode still fits within its allocated space, there is no problem for the scanner and the system receiving the data. Using FNC1 rather than <GS> is still preferred in GS1 DataMatrix.

GS1 QR Code cannot use FNC1 as this is not available as a character, so '%' or 'GS' has to be used. (QR Code uses a Function 1 mode character in its first position to indicate that the symbol is a GS1 QR Code, but this is not the same as a Function 1 symbol character.)

FNC1 is still the better option as a data separator for GS1-128 (it appears in all three characters sets) but using <GS> instead causes no scanning problems. To allow for <GS> to be used would mean that some barcodes created sub-optimally will be acceptable rather than rejected by a verifier. A warning and advice about ideally using FNC1 can still be provided to users.

Note: The original text for this GSCN includes the changes made to version 16 of the GS1 General Specifications by GSCN 15-306.

GS1 General Specification Change:



3.1 Introduction

This section describes the meaning, structure, and function of the GS1 system element strings so they can be correctly processed in users' application programmes. An element string is the combination of a GS1 Application Identifier and a GS1 Application Identifier data field. The allowable character set to be used for GS1 Application Identifier element strings is defined in section [7.117.117.11](#). There are AIs that have additional syntax restrictions, e.g. numerical only; see below definition for each AI.

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Automatic processing of element strings in business applications requires information about the type of transaction to which the transferred data refers. See section 7 for an explanation of this process. Element strings can be carried by GS1-128, GS1 DataBar symbology, GS1 Composite, GS1 DataMatrix and GS1 QR Code symbols. The rules for use and interrelationships between the [GS1 Application Identifiers](#) are contained in section 2 and 4.

When a pre-defined length GS1 key and attributes are encoded together, the GS1 key SHOULD appear before the attributes. In most cases pre-defined length element strings SHOULD be followed by non-pre-defined element strings. The sequence of pre-defined and non-pre-defined element strings should be at the discretion of the [brand-owner/creator of the element strings](#).

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3.2 GS1 Application Identifiers in numerical order

Figure 3.2-1. GS1 Application Identifiers

| AI | Data Content | Format (*) | FNC1 required (***) | Data title |
|---------|--|--------------|---------------------|-------------------------|
| 00 | Serial Shipping Container Code (SSCC) | N2+N18 | | SSCC |
| 01 | Global Trade Item Number (GTIN) | N2+N14 | | GTIN |
| 02 | GTIN of contained trade items | N2+N14 | | CONTENT |
| 10 | Batch or lot number | N2+X..20 | (FNC1) | BATCH/LOT |
| 11 (**) | Production date (YYMMDD) | N2+N6 | | PROD DATE |
| 12 (**) | Due date (YYMMDD) | N2+N6 | | DUE DATE |
| 13 (**) | Packaging date (YYMMDD) | N2+N6 | | PACK DATE |
| 15 (**) | Best before date (YYMMDD) | N2+N6 | | BEST BEFORE or BEST BY |
| 16 (**) | Sell by date (YYMMDD) | N2+N6 | | SELL BY |
| 17 (**) | Expiration date (YYMMDD) | N2+N6 | | USE BY OR EXPIRY |
| 20 | Variant number | N2+N2 | | VARIANT |
| 21 | Serial number | N2+X..20 | (FNC1) | SERIAL |
| 240 | Additional item identification | N3+X..30 | (FNC1) | ADDITIONAL ID |
| 241 | Customer part number | N3+X..30 | (FNC1) | CUST. PART NO. |
| 242 | Made-to-Order variation number | N3+N..6 | (FNC1) | MTO VARIANT |
| 243 | Packaging component number | N3+X..20 | (FNC1) | PCN |
| 250 | Secondary serial number | N3+X..30 | (FNC1) | SECONDARY SERIAL |
| 251 | Reference to source entity | N3+X..30 | (FNC1) | REF. TO SOURCE |
| 253 | Global Document Type Identifier (GDTI) | N3+N13+X..17 | (FNC1) | GDTI |
| 254 | GLN extension component | N3+X..20 | (FNC1) | GLN EXTENSION COMPONENT |
| 255 | Global Coupon Number (GCN) | N3+N13+N..12 | (FNC1) | GCN |
| 30 | Count of items (variable measure trade item) | N2+N..8 | (FNC1) | VAR. COUNT |



| AI | Data Content | Format (*) | FNC1 required (****) | Data title |
|---------------------------|--|------------|----------------------|-------------------------------|
| 310 _n (***) | Net weight, kilograms (variable measure trade item) | N4+N6 | | NET WEIGHT (kg) |
| 311 _n (***) | Length or first dimension, metres (variable measure trade item) | N4+N6 | | LENGTH (m) |
| 312 _n (***) | Width, diameter, or second dimension, metres (variable measure trade item) | N4+N6 | | WIDTH (m) |
| 313 _n (***) | Depth, thickness, height, or third dimension, metres (variable measure trade item) | N4+N6 | | HEIGHT (m) |
| 314 _n (***) | Area, square metres (variable measure trade item) | N4+N6 | | AREA (m ²) |
| 315 _n (***) | Net volume, litres (variable measure trade item) | N4+N6 | | NET VOLUME (l) |
| 316 _n (***) | Net volume, cubic metres (variable measure trade item) | N4+N6 | | NET VOLUME (m ³) |
| 320 _n (***) | Net weight, pounds (variable measure trade item) | N4+N6 | | NET WEIGHT (lb) |
| 321 _n (***) | Length or first dimension, inches (variable measure trade item) | N4+N6 | | LENGTH (i) |
| 322 _n (***) | Length or first dimension, feet (variable measure trade item) | N4+N6 | | LENGTH (f) |
| 323 _n (***) | Length or first dimension, yards (variable measure trade item) | N4+N6 | | LENGTH (y) |
| 324 _n (***) | Width, diameter, or second dimension, inches (variable measure trade item) | N4+N6 | | WIDTH (i) |
| 325 _n (***) | Width, diameter, or second dimension, feet (variable measure trade item) | N4+N6 | | WIDTH (f) |
| 326 _n (***) | Width, diameter, or second dimension, yards (variable measure trade item) | N4+N6 | | WIDTH (y) |
| 327 _n (***) | Depth, thickness, height, or third dimension, inches (variable measure trade item) | N4+N6 | | HEIGHT (i) |
| 328 _n (***) | Depth, thickness, height, or third dimension, feet (variable measure trade item) | N4+N6 | | HEIGHT (f) |
| 329 _n (***) | Depth, thickness, height, or third dimension, yards (variable measure trade item) | N4+N6 | | HEIGHT (y) |
| 330 _n (***) | Logistic weight, kilograms | N4+N6 | | GROSS WEIGHT (kg) |
| 331 _n (***) | Length or first dimension, metres | N4+N6 | | LENGTH (m), log |
| 332 _n (***) | Width, diameter, or second dimension, metres | N4+N6 | | WIDTH (m), log |
| 333 _n (***) | Depth, thickness, height, or third dimension, metres | N4+N6 | | HEIGHT (m), log |
| 334 _n (***) | Area, square metres | N4+N6 | | AREA (m ²), log |
| 335 _n (***) | Logistic volume, litres | N4+N6 | | VOLUME (l), log |
| 336 _n (***) | Logistic volume, cubic metres | N4+N6 | | VOLUME (m ³), log |
| 337 _n (***) | Kilograms per square metre | N4+N6 | | KG PER m ² |

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| AI | Data Content | Format (*) | FNC1 required (****) | Data title |
|---------------|--|------------|----------------------|-----------------------------|
| 340n (***) | Logistic weight, pounds | N4+N6 | | GROSS WEIGHT (lb) |
| 341n (***) | Length or first dimension, inches | N4+N6 | | LENGTH (i), log |
| 342n (***) | Length or first dimension, feet | N4+N6 | | LENGTH (f), log |
| 343n (***) | Length or first dimension, yards | N4+N6 | | LENGTH (y), log |
| 344n (***) | Width, diameter, or second dimension, inches | N4+N6 | | WIDTH (i), log |
| 345n (***) | Width, diameter, or second dimension, feet | N4+N6 | | WIDTH (f), log |
| 346n (***) | Width, diameter, or second dimension, yard | N4+N6 | | WIDTH (y), log |
| 347n (***) | Depth, thickness, height, or third dimension, inches | N4+N6 | | HEIGHT (i), log |
| 348n (***) | Depth, thickness, height, or third dimension, feet | N4+N6 | | HEIGHT (f), log |
| 349n (***) | Depth, thickness, height, or third dimension, yards | N4+N6 | | HEIGHT (y), log |
| 350n (***) | Area, square inches (variable measure trade item) | N4+N6 | | AREA (i ²) |
| 351n (***) | Area, square feet (variable measure trade item) | N4+N6 | | AREA (f ²) |
| 352n (***) | Area, square yards (variable measure trade item) | N4+N6 | | AREA (y ²) |
| 353n (***) | Area, square inches | N4+N6 | | AREA (i ²), log |
| 354n (***) | Area, square feet | N4+N6 | | AREA (f ²), log |
| 355n (***) | Area, square yards | N4+N6 | | AREA (y ²), log |
| 356n (***) | Net weight, troy ounces (variable measure trade item) | N4+N6 | | NET WEIGHT (t) |
| 357n (***) | Net weight (or volume), ounces (variable measure trade item) | N4+N6 | | NET VOLUME (oz) |
| 360n (***) | Net volume, quarts (variable measure trade item) | N4+N6 | | NET VOLUME (q) |
| 361n (***) | Net volume, gallons U.S. (variable measure trade item) | N4+N6 | | NET VOLUME (g) |
| 362n (***) | Logistic volume, quarts | N4+N6 | | VOLUME (q), log |
| 363n (***) | Logistic volume, gallons U.S. | N4+N6 | | VOLUME (g), log |
| 364n (***) | Net volume, cubic inches (variable measure trade item) | N4+N6 | | VOLUME (i ³) |
| 365n (***) | Net volume, cubic feet (variable measure trade item) | N4+N6 | | VOLUME (f ³) |
| 366n (***) | Net volume, cubic yards (variable measure trade item) | N4+N6 | | VOLUME (y ³) |



| AI | Data Content | Format (*) | FNC1 required (****) | Data title |
|------------|--|-------------|----------------------|-------------------------------|
| 367n (***) | Logistic volume, cubic inches | N4+N6 | | VOLUME (i ³), log |
| 368n (***) | Logistic volume, cubic feet | N4+N6 | | VOLUME (F ³), log |
| 369n (***) | Logistic volume, cubic yards | N4+N6 | | VOLUME (y ³), log |
| 37 | Count of trade items | N2+N..8 | (FNC1) | COUNT |
| 390n (***) | Applicable amount payable or Coupon value, local currency | N4+N..15 | (FNC1) | AMOUNT |
| 391n (***) | Applicable amount payable with ISO currency code | N4+N3+N..15 | (FNC1) | AMOUNT |
| 392n (***) | Applicable amount payable, single monetary area (variable measure trade item) | N4+N..15 | (FNC1) | PRICE |
| 393n (***) | Applicable amount payable with ISO currency code (variable measure trade item) | N4+N3+N..15 | (FNC1) | PRICE |
| 394n (***) | Percentage discount of a coupon | N4+N4 | (FNC1) | PRCNT OFF |
| 400 | Customer's purchase order number | N3+X..30 | (FNC1) | ORDER NUMBER |
| 401 | Global Identification Number for Consignment (GINC) | N3+X..30 | (FNC1) | GINC |
| 402 | Global Shipment Identification Number (GSIN) | N3+N17 | (FNC1) | GSIN |
| 403 | Routing code | N3+X..30 | (FNC1) | ROUTE |
| 410 | Ship to - Deliver to Global Location Number | N3+N13 | | SHIP TO LOC |
| 411 | Bill to - Invoice to Global Location Number | N3+N13 | | BILL TO |
| 412 | Purchased from Global Location Number | N3+N13 | | PURCHASE FROM |
| 413 | Ship for - Deliver for - Forward to Global Location Number | N3+N13 | | SHIP FOR LOC |
| 414 | Identification of a physical location - Global Location Number | N3+N13 | | LOC No |
| 415 | Global Location Number of the invoicing party | N3+N13 | | PAY TO |
| 420 | Ship to - Deliver to postal code within a single postal authority | N3+X..20 | (FNC1) | SHIP TO POST |
| 421 | Ship to - Deliver to postal code with ISO country code | N3+N3+X..9 | (FNC1) | SHIP TO POST |
| 422 | Country of origin of a trade item | N3+N3 | (FNC1) | ORIGIN |
| 423 | Country of initial processing | N3+N3+N..12 | (FNC1) | COUNTRY - INITIAL PROCESS. |
| 424 | Country of processing | N3+N3 | (FNC1) | COUNTRY - PROCESS. |
| 425 | Country of disassembly | N3+N3+N..12 | (FNC1) | COUNTRY - DISASSEMBLY |
| 426 | Country covering full process chain | N3+N3 | (FNC1) | COUNTRY - FULL PROCESS |
| 427 | Country subdivision Of origin | N3+X..3 | (FNC1) | ORIGIN SUBDIVISION |
| 7001 | NATO Stock Number (NSN) | N4+N13 | (FNC1) | NSN |

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| AI | Data Content | Format (*) | FNC1 required (****) | Data title |
|----------------|---|--------------|----------------------|-------------------|
| 7002 | UN/ECE meat carcasses and cuts classification | N4+X..30 | (FNC1) | MEAT CUT |
| 7003 | Expiration date and time | N4+N10 | (FNC1) | EXPIRY TIME |
| 7004 | Active potency | N4+N..4 | (FNC1) | ACTIVE POTENCY |
| 7005 | Catch area | N4+X..12 | (FNC1) | CATCH AREA |
| 7006 | First freeze date | N4+N6 | (FNC1) | FIRST FREEZE DATE |
| 7007 | Harvest date | N4+N6..12 | (FNC1) | HARVEST DATE |
| 7008 | Species for fishery purposes | N4+X..3 | (FNC1) | AQUATIC SPECIES |
| 7009 | Fishing gear type | N4+X..10 | (FNC1) | FISHING GEAR TYPE |
| 7010 | Production method | N4+X..2 | (FNC1) | PROD METHOD |
| 703s | Number of processor with ISO Country Code | N4+N3+X..27 | (FNC1) | PROCESSOR # s |
| 710 | National Healthcare Reimbursement Number (NHRN) – Germany PZN | N3+X..20 | (FNC1) | NHRN PZN |
| 711 | National Healthcare Reimbursement Number (NHRN) – France CIP | N3+X..20 | (FNC1) | NHRN CIP |
| 712 | National Healthcare Reimbursement Number (NHRN) – Spain CN | N3+X..20 | (FNC1) | NHRN CN |
| 713 | National Healthcare Reimbursement Number (NHRN) – Brasil DRN | N3+X..20 | (FNC1) | NHRN DRN |
| ###-... (****) | National Healthcare Reimbursement Number (NHRN) – Country "A" NHRN | N3+X..20 | (FNC1) | NHRN xxx |
| 8001 | Roll products (width, length, core diameter, direction, splices) | N4+N14 | (FNC1) | DIMENSIONS |
| 8002 | Cellular mobile telephone identifier | N4+X..20 | (FNC1) | CMT No |
| 8003 | Global Returnable Asset Identifier (GRAI) | N4+N14+X..16 | (FNC1) | GRAI |
| 8004 | Global Individual Asset Identifier (GIAI) | N4+X..30 | (FNC1) | GIAI |
| 8005 | Price per unit of measure | N4+N6 | (FNC1) | PRICE PER UNIT |
| 8006 | Identification of the components of a trade item | N4+N14+N2+N2 | (FNC1) | GCTIN |
| 8007 | International Bank Account Number (IBAN) | N4+X..34 | (FNC1) | IBAN |
| 8008 | Date and time of production | N4+N8+N..4 | (FNC1) | PROD TIME |
| 8010 | Component / Part Identifier (CPID) | N4 + X..30 | (FNC1) | CPID |
| 8011 | Component / Part Identifier serial number (CPID SERIAL) | N4 + N..12 | (FNC1) | CPID SERIAL |
| 8012 | Software version | N4 + X..20 | (FNC1) | VERSION |
| 8017 | Global Service Relation Number to identify the relationship between an organisation offering services and the provider of services | N4+N18 | (FNC1) | GSRN - PROVIDER |
| 8018 | Global Service Relation Number to identify the relationship between an organisation offering services and the recipient of services | N4+N18 | (FNC1) | GSRN - RECIPIENT |
| 8019 | Service Relation Instance Number (SRIN) | N4+N..10 | (FNC1) | SRIN |
| 8020 | Payment slip reference number | N4+X..25 | (FNC1) | REF No |



| AI | Data Content | Format (*) | FNC1 required (****) | Data title |
|----------|---|------------|----------------------|-------------|
| 8110 | Coupon code identification for use in North America | N4+X..70 | (FNC1) | - |
| 8111 | Loyalty points of a coupon | N4+N4 | (FNC1) | POINTS |
| 8112 | Paperless coupon code identification for use in North America | N4+X..70 | (FNC1) | - |
| 8200 | Extended Packaging URL | N4+X..70 | (FNC1) | PRODUCT URL |
| 90 | Information mutually agreed between trading partners | N2+X..30 | (FNC1) | INTERNAL |
| 91 to 99 | Company internal information | N2+X..30 | (FNC1) | INTERNAL |

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NOTES:

(*): The first position indicates the length (number of digits) of the GS1 Application Identifier. The following value refers to the format of the data content. The following convention is applied:

- n implied decimal point position
- N numeric digit
- X any character in [Figure 7.11-1](#)[Figure 7.11-1](#)[Figure 7.11-1](#)
- N3 3 numeric digits, predefined fixed length
- N..3 up to 3 numeric digits
- X..3 up to 3 characters in [Figure 7.11-1](#)[Figure 7.11-1](#)[Figure 7.11-1](#)

(**): If only year and month are available, DD must be filled with two zeroes.

(***): The fourth digit of this GS1 Application Identifier indicates [the number of decimal places \(and in that way the implied decimal point position\)](#).

Example:

- 3100 Net weight in kg without a decimal point
- 3102 Net weight in kg with two decimal [places](#)[points](#)

(****): [All GS1 element strings that begin with Application Identifiers not contained in the predefined table shown in Figure 5.10.1-2 SHALL be separated by a separator character unless this element string is the last one to be encoded in the symbol. For details on the separator character see section 7.8.3. All GS1 Application Identifiers indicated with \(FNC1\) are defined as of variable length and SHALL be delimited unless this element string is the last one to be encoded in the symbol. The delimiter SHALL be a Function 1 Symbol Character in GS1-128 symbology, GS1 DataBar Expanded Versions and GS1 Composite symbology and SHOULD be a Function 1 Symbol Character in GS1 DataMatrix and GS1 QR Code symbology.](#)

(*****): An example to illustrate future additional [National Healthcare Reimbursement Numbers \(NHRNs\)](#). If additional NHRN AIs are required, a request for a new NHRN AI SHALL be made through the GS1 GSMP.

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3.3 GS1 Application Identifiers starting with digit 0

3.3.1 Identification of a logistic unit (SSCC): AI (00)

The GS1 Application Identifier (00) indicates that the GS1 Application Identifier data field contains an SSCC (Serial Shipping Container Code). The SSCC is used to identify logistic units (see section [2.22.22.2](#)).

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The extension digit is used to increase the capacity of the serial reference within the SSCC. It is assigned by the company that constructs the SSCC. The extension digit ranges from 0-9.

The GS1 Company Prefix is allocated by GS1 Member Organisations to the company that allocates the SSCC – here the physical builder or the brand owner of the logistic unit (see section [1.4.4](#)). It makes the SSCC unique worldwide but does not identify the origin of the unit.

| If element string | | Then mandatory associated element string | Comment |
|-------------------|----------------------------|--|---|
| 8111 | Loyalty points of a coupon | 255 | Mandatory association with the Global Coupon Number |
| 8200 | Extended packaging URL | 01 | Mandatory association with GTIN |

- * Is (3nnn) where the first three digits are 312, 313, 324, 325, 326, 327, 328, and 329
- ** Is (3nnn) where the first three digits are 310, 311, 314, 315, 316, 320, 321, 322, 323, 350, 351, 352, 356, 357, 360, 361, 364, 365, and 366
- *** Is (3nnn) where the first three digits are 330, 331, 332, 333, 334, 335, 336, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 353, 354, 355, 362, 363, 367, 368, and 369

Note: Exception for point-of-sale. See figure 2.7-1. Areas of GS1 system application.

4.14 Human readable interpretation (HRI) rules

Human readable interpretation rules are provided to standardise [printing requirements for brand owners and users to](#) and facilitate [common training of staff on how to deal with](#) ~~for operators who encounter~~ GS1 AIDC data carriers that fail to scan or read. There are two categories of rules:

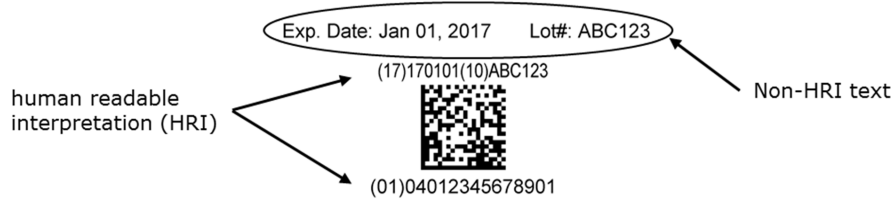
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- General rules that apply independent of sector, product category, or region.
- Sector specific rules which must be aligned with the general rules.

For the purposes of interpreting this standard, there are two types of text that appear on a label, package, or item; human readable interpretation (HRI) and non-HRI text.

- Human readable interpretation (HRI) is the information below, beside or above a barcode or tag which is encoded in the barcode or tag and represents the same characters as carried in the barcode or tag (See section 8 Glossary for full definition).
- Non-HRI text is all other text on package, label or item (See section 8 Glossary for full definition).

Figure 4.14-1. Example of HRI and non-HRI text



Note: The following rules are intended for global use. Exceptions may occur only when local regulatory or legal requirements mandate otherwise.

Note: At present, HRI rules are applicable to barcodes as rules for EPC/RFID tags are under development.

Note: [HRI rules for the EAN/UPC symbology and the add-on symbols are explained in section 5.2.3 Human Readable Interpretation.](#)

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Human readable interpretation rules

- **Rule 1.** Whether a GS1 AIDC data carrier encodes a GS1 identification key, GS1 key attributes, or a combination of both, the HRI SHOULD be placed below the barcode and grouped together wherever physically possible while maintaining the HRI legibility and minimum barcode height (as specified in the appropriate symbol specification table referenced by the GS1 AIDC application standard).
 - a. In cases where the HRI must be printed above, to the left, or to the right of the symbol due to packaging or space constraints, HRI SHALL always be printed adjacent to (obviously associated with) the GS1 AIDC data carrier while protecting Quiet Zones.
 - b. If the HRI for GS1 identification keys and GS1 key attributes is split (for example GS1 key HRI is below the barcode and GS1 key attributes HRI is above the barcode), the preference for GS1 key HRI placement is always below the barcode.
 - c. When HRI is grouped together (for example, all HRI data is grouped below the barcode or all HRI data is grouped above the barcode), HRI SHALL always follow the encoding sequencing of the GS1 AIDC data carrier.
- **Rule 2.** A single data element SHALL ~~NOT~~ be broken into two lines of HRI, for example the data for a serial number would appear on one line of HRI.
- **Rule 3.** Parentheses SHALL surround AIs in HRI but are not encoded in the GS1 AIDC data carrier.
- **Rule 4.** A clearly legible font SHALL be used (e.g., OCR-B as defined in *ISO 1073-2*) and the character set as defined in section ~~2.17.17.11~~. Reasonable alternative type fonts and character sizes are acceptable provided the interpretation is clearly legible.
- **Rule 5.** On GS1 Logistics labels HRI characters SHALL be no less than 3 mm (0.1181 inch) high
- **Rule 6.** HRI SHALL be limited to element strings and will not include GS1 AIDC data carrier overhead such as ~~FNC1 separator~~ characters.
- **Rule 7.** If the required barcode and associated HRI is marked directly on the part, then both satisfy the requirements for healthcare primary package marking (see section [2.1.2.3](#)) if the barcode can be scanned and the HRI is legible through a panel in the primary packaging.
- **Rule 8.** HRI SHALL appear except in rare circumstances for specific applications where there are extreme space constraints (e.g., direct part marking). If the GS1 AIDC data carrier cannot be read or scanned and the HRI does not appear on the label, package, or item, non-HRI text SHOULD be used as backup information.

As a non-HRI text option, the data title (see section 3.2) may be associated with the data instead of using the AI numbers. See figure 4.14-1 which shows expiry date and lot number identified with non-HRI text and in the same figure where the same data is shown using the all-AI format. These presentations can be used with all GS1 AIDC data carriers using GS1 Application Identifiers, except GS1-128 Symbology.
- **Rule 9.** For symbols (Composite symbol, GS1 DataMatrix) encoding a large amount of data, it may not be practical to display all the data in human readable interpretation form or, even if there is space to show it in this form, it may not be practical to key enter that much data. In these instances, some of the data may be omitted from the human readable interpretation. However, primary identification data (GS1 system keys) such as the Global Trade Item Number (GTIN) or Global Document Type Identifier (GDTI) must always be shown. Application specifications provide guidance on human readable interpretation.

Figure 4.14-2. HRI with some of the data omitted



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- The Function 1 Symbol Character (FNC1) SHALL be subject to the special considerations defined in section 5.4.3.65-4.3.65.4.3.6. An FNC1 in the first position following the start character of a Code-128 symbol is at all times a reserved use, which identifies the GS1 system.
- The Function 2 Character (FNC2) (Message Append) is not used in the GS1 system. It instructs the barcode reader to temporarily store the data from the symbol containing the FNC2 and transmit it as a prefix to the data of the next symbol. This may be used to concatenate several symbols before transmission. This character may occur anywhere in the symbol. Where the sequence of data is significant, provision should be made to ensure reading of the symbols in the correct sequence.
- The Function 3 Character (FNC3) (Initialise) instructs the barcode reader to interpret the data from the symbol containing the FNC3 as instructions for initialisation or reprogramming of the barcode reader. The data from the symbol SHALL NOT be transmitted by the barcode reader. This character may occur anywhere in the symbol.
- The Function 4 Character (FNC4) is not used in the GS1 system. In Code 128 symbols, FNC4 is used to represent an extended ASCII character set (byte values 128 to 255) as specified in *ISO 8859-1: Information technology; 8-bit single-byte coded graphical character sets; Part 1: Latin alphabet No. 1*, or otherwise in an application specification. If a single FNC4 is used, the value 128 is added to the ASCII value of the following data character in the symbol. A shift character may follow the FNC4 if it is necessary to change the code set for the following data character. Subsequent data characters revert to the standard ASCII set. If two consecutive FNC4s are used, the value 128 is added to the ASCII value of the following data characters until two further consecutive FNC4s are encountered or the end of the symbol is reached. If, during this sequence of extended ASCII encodation, a single FNC4 is encountered, it is used to revert to standard ASCII encodation for the next data character only. Shift and code set characters SHALL have their normal effect during such a sequence. The default reference character set for extended ASCII values 128 to 255 is the corresponding half of *ISO 8859-1, Latin alphabet 1*, but application specifications may define or reference alternative sets corresponding to byte values 128 to 255.

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5.4.3.5 Start and stop characters

- Start characters A, B, and C define the corresponding code set to be used initially in the symbol.
- The stop character is common to all code sets.
- The decoder SHALL NOT transmit start and stop characters.

5.4.3.6 Symbol check character

The symbol check character SHALL be included as the last symbol character before the stop character. Section 5.4.7.6.15-4.7.6.15-4.7.6.1 defines the algorithm for its calculation. The symbol check character SHALL NOT be represented in the human readable interpretation nor shall it be transmitted by the decoder.

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5.4.3.7 GS1-128 symbology start pattern

The GS1-128 symbology has special double character start patterns consisting of start (A, B, or C) and FNC1. These special start characters differentiate GS1-128 barcodes from the more generalised Code 128 symbols.

In other words, a Code 128 symbol, which begins with one of the GS1-128 symbology double character start patterns, is always a GS1-128 barcode; a Code 128 symbol, which does not begin with this start pattern, is never a GS1-128 barcode.

A Function 1 Symbol Character (FNC1) may be the symbol check character (in less than 1 percent of cases). It is also used as a separator character, when appropriate, if GS1 Application Identifiers (AIs) and their data field element strings are concatenated into a single barcode.

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- Start A begins the GS1-128 symbol data encodation according to character set A.
- Start B begins the GS1-128 symbol data encodation according to character set B.



- The measurements for height and each Quiet Zone have an Acceptance Criteria of 5% (-5% on the minimum specified dimension and +5% on the maximum specified dimension).

5.5.3.3.10.3 EAN/UPC symbology

The main characteristic of the EAN/UPC symbology that affects verification is the different treatment of the three sets of symbol characters for digits 1, 2, 7, and 8 from the remaining digits (0, 3, 4, 5, 6, and 9). The reference decode algorithm uses the combined width of both bars in these characters to discriminate between a 1 and a 7, and between a 2 and an 8, which are ambiguously decodable since they share the same set of edge-to-similar-edge modular dimensions. The addition to or subtraction from the element widths of 1/13 module is intended to increase the differences between the sums of the bar widths for each pair of ambiguous characters. The decodability parameter for these characters takes account of bar gain and loss whereas it does not for the remaining symbol characters. Consequently, a symbol not containing any of these four symbol characters may suffer substantial bar gain or loss without degrading its decodability, whereas a symbol that does contain one or more of them is likely to have a lower decodability grade, with the same amount of bar gain or loss. However, the laws of probability suggest that only some 6.9 percent of symbols would not be affected by this, so it is wise to be cautious and assume that bar gain or loss is a possible cause of a poor decodability grade for EAN/UPC symbols. It is also wise (for process control purposes) not to assume that the decodability grade correlates with bar width deviation, but it is far safer and easier to rely on the traditional measurement of bar width deviation for adjusting the production process.

The measuring aperture for EAN/UPC symbols is either 6 or 10 mils, depending on the application, as specified by the symbol specification tables.

Additional EAN/UPC symbol grading criteria

ISO/IEC 15416 Bar code print quality test specification - Linear symbols allows for additional pass/fail criteria to be stipulated by a symbology specification. For the EAN/UPC symbology, the minimum Quiet Zone dimensions are given in [5.2.1.4.45-2.1.4.45-2.1.4.4](#). Any individual scan profile which does not meet these requirements allowing for the following tolerances SHALL receive a grade of "0".

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Figure 5.5.3.3.10.3-1. Minimum width of measured Quiet Zones

| Symbol version | Left Quiet Zone | Right Quiet Zone |
|------------------|-------------------|------------------|
| EAN-13 | 10X | 6.2X |
| EAN-8 | 6.2X | 6.2X |
| UPC-A | 8X | 8X |
| UPC-E | 8X | 6.2X |
| Add-ons (EAN) | EAN 13/8 right QZ | 4.2X |
| Add-ons (U.P.C.) | UPC A/E right QZ | 4.2X |

Symbols that fall below range defined in [5.2.3.7-1](#) magnification factors SHALL receive a grade of 0 (see [5.5.3.4.3](#) for exception).

- ✓ **Note:** The choice of minimum Quiet Zone dimension was based on the historical U.P.C. Quality Guideline. Since EAN-13 and EAN-8 were not included, minimum Quiet Zone dimension similarly derived were chosen for those symbols.

5.5.3.3.10.4 GS1-128 symbology

The important aspects to verify for a GS1-128 symbol are its print quality, which is assessed in the standard way, and its formatting, which may need to be visually checked from the information output by the verifier. The Code 128 symbology is an edge-to-similar- edge decodable symbology, but its reference decode algorithm also requires a check of the sum of the widths of the three bars in each character as part of its parity checking process. Consequently, its decodability is affected by bar gain or loss.



Measuring apertures for GS1-128 symbols are 6 or 10 mils depending on the application and are specified in the symbol specification tables.

Data contained in GS1-128 symbols must be formatted according to these specifications for the use of GS1 Application Identifiers (AIs). Specific features to check are:

- Presence of Function 1 Symbol Character (FNC1) as a flag for the GS1 system subset of the Code 128 symbol, in the first position after the start character.
- Use of FNC1 or the control character <GS> (ASCII value 29 (decimal), 1D (hexadecimal)) as a field separator character following non-predefined length A+element strings.
- Sequencing of AIs, with pre-defined length AIs preceding non-pre-defined length ones.
- Length of data fields with fixed length AIs.
- Correct formatting of data in all AI fields.
- Absence of encoded parentheses around AIs.
- The extent to which a verifier can do this automatically will vary greatly among devices, even those that have GS1-128 symbols as a specific symbology option.

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5.5.3.3.10.5 ITF-14 symbology

ITF-14 barcodes are, unlike the others used in the GS1 system, two-width (narrow/wide) symbols that cannot be decoded by the edge-to-similar-edge technique, but all element widths must be measured. They are, therefore, more subject to the problems caused by bar gain or loss.

The standard ISO verification technique is fully applicable to these symbols. However, in the GS1 system application, additional checks must be made to ensure that the X-dimension (magnification factor) is within the permitted range.

Measuring apertures for the ITF-14 symbol SHALL be 10 mils for symbols with an X-dimension less than 0.635 millimetre (0.0250 in) and SHALL be 20 mils for symbols with an X-dimension equal to or greater than 0.635 millimetre (0.0250 in).

The minimum acceptable grade for symbols printed with the higher range of X-dimension (above 0.635 millimetre or 0.0250 in) SHALL be 0.5/20/660. This is because the brown corrugated substrates on which such symbols are often printed typically have a reflectance value below 40 percent, and sometimes below 30 percent, and cannot, therefore, ever achieve a symbol contrast better than 40 percent (the lower threshold for a grade 2 symbol contrast) no matter how dense the ink or how well the other attributes of the symbol are graded. As a result, the Scan Reflectance Profile (SRP) grade will most often be dictated by symbol contrast, so it cannot be higher than 1 for symbols on these materials, giving a maximum achievable overall symbol grade of 1.0.

Such symbols may also be affected by the inherent interference in the background reflectance caused by the substrate's composition, which may well lead to reduced defect grades and possibly low edge contrast and modulation values. It is, therefore, desirable to ensure that symbols printed on these corrugated materials are of as high a quality as possible in respect of the other parameters.

5.5.3.3.10.6 GS1 DataMatrix

Determining symbol quality for items marked with GS1 DataMatrix (both traditionally printed and direct part marked - DPM) involves a specialised approach due to the physical nature of the marking and the optical systems used to read those marks. The minimum symbol quality grade for GS1 DataMatrix symbols SHALL be specified by the application specification. The measurement of the quality parameters for DPM symbols SHALL be made by a verifier conforming to *ISO/IEC 15415* and when direct marked augmented with *ISO/IEC TR 29158* which defines DPM quality specific alternative illumination conditions, terms, parameters, modifications to the measurement and grading of certain parameters and the reporting of the grading results. According to these standards an overall grade is shown in the form:

Grade/Aperture/Light/Angle

Where:

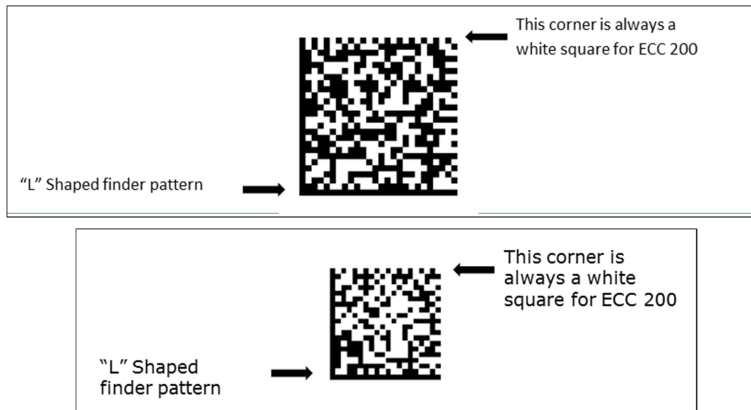
- Use with B2C Extended Packaging applications.

GS1 DataMatrix symbols are read by two-dimensional imaging scanners or vision systems. Most other scanners that are not two-dimensional imagers cannot read GS1 DataMatrix. GS1 DataMatrix symbols are restricted for use with *new-niche* applications that will involve imaging scanners throughout the supply chain.

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5.7.2 GS1 DataMatrix features and symbol basics

Figure 5.7.2-1. GS1 DataMatrix symbol



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- Figure 5.7.2-1 represents a GS1 DataMatrix symbol with 20 rows and 20 columns (including the perimeter finder pattern but not including Quiet Zones).
- GS1 DataMatrix solid "L" shaped finder or alignment pattern is one module wide.
- GS1 DataMatrix Quiet Zone is one module wide on all four sides. As with other barcode Quiet Zones, do not print in this area.
- ECC 200 symbols can always be recognised from older versions of Data Matrix because the corner opposite the middle of the finder pattern is a zero module or white in normal print.
- For square GS1 DataMatrix symbols, only an even number of rows and columns exist. Depending on data requirements, symbols can range from 10 row by 10 columns (10 x10) to 144x144 (including finder pattern but not the Quiet Zone).
- For normal printing, a module is one X by one X in dimension. Representation of data: A dark module is a binary one and a light module is a binary zero (or a light module is a binary one and a dark module is a binary zero for a symbol with reflectance reversal).
- ECC 200 (ECC = Error Checking and Correction) that uses Reed-Solomon error correction. Figure 5.7.3.2-1 ECC 200 Square Symbol attributes, shows the fixed amounts of error correction associated for each allowable Data Matrix symbol size.
- FNC1 for GS1 system compatibility SHALL be encoded at the beginning of the data string, ~~and SHOULD be used as a group. When a separator character is needed at the end of an element string, either the Function 1 Symbol Character (FNC1) or the control character <GS> (ASCII value 29 (decimal), 1D (hexadecimal)) SHALL be used and~~ ~~When a FNC1 is used as a group separator, it SHALL be represented in the transmitted message by the ASCII control character <GS> (ASCII value 29 (decimal), 1D (hexadecimal)).~~
- Encodable character set:
 - The GS1 system requires that only the subset of *ISO/IEC 646 International Reference Version* defined in these *GS1 General Specifications* be used for GS1 Application Identifier (AI) element strings. Refer to ~~Figure 7.11-1~~~~Figure 7.11-1~~~~Figure 7.11-1~~ for the allowed encodable character set.

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- Data characters per symbol (for the maximum symbol size):
 - Alphanumeric data: up to 2335 characters.
 - Eight-bit byte data: 1556 characters.
 - Numeric data: 3116 digits.
- Large, square ECC symbols (at least 32 X32) will include alignment patterns to separate the data regions.
- Code type: matrix (Composite Component is a stacked type).
- Orientation independence: Yes (requires a two-dimensional imaging scanner).
- Summary of additional features inherent or optional in GS1 DataMatrix:
 - Reflectance reversal: (Inherent) Symbols can be read when marked so that the image is either dark on light or light on dark.
 - Rectangular symbols: Six symbol formats are specified in a rectangular form.
 - Extended Channel Interpretation (ECI) capability allows GS1 DataMatrix to encode data from other alphabets.

5.7.3 GS1 DataMatrix symbology

The technical description of GS1 DataMatrix contained within this section provides additional information based on *ISO technical specification 16022*, and it is provided as a further aid in the development of specific applications. GS1 DataMatrix symbols shown in the following subsections have been magnified to show detail.

5.7.3.1 Square and rectangular formats

GS1 DataMatrix may be printed in a square or rectangular format. The square format is usually used as it has a larger range of sizes and is the only format available for symbols encoding a large amount of data. The largest rectangular symbol can encode 98 digits, while the largest square symbol can encode 3,116 digits. An enlarged rectangular symbol and an equivalent square symbol are shown in the figure below.

Figure 5.7.3.1-1. Rectangular and square GS1 DataMatrix symbols
(Specific applications are not used in the data encodation.
Both symbols contain the same data)



5.7.3.2 GS1 DataMatrix symbol sizes

GS1 DataMatrix symbology has multiple sizes to match various data content (see figure 5.7.3.2-1). GS1 DataMatrix symbols have 24 sizes of the square format ranging from 10 by 10 modules up to 144 by 144 modules, not including the 1-X surrounding Quiet Zone. The rectangular format has 6 sizes from 8 by 18 modules up to 16 by 48 modules, not including the 1-X surrounding Quiet Zone. GS1 DataMatrix sizes of 52 by 52 or larger have 2 to 10 interleaved blocks of Reed-Solomon error correction codewords.

The term "codeword" is used often to describe attributes concerning the encodation of data into GS1 DataMatrix symbols. *ISO 16022* defines codeword as "A symbol character value. An intermediate level of coding between source data and the graphical encodation in the symbol." Codewords are typically eight bits of data. FNC1, two numerics, and one alpha all take up one codeword each.



5.7.3.6 Advice for selecting the symbology

Any use of GS1 DataMatrix should comply with GS1 system global application guidelines and be restricted to those applications defined by the GS1 system for GS1 DataMatrix. GS1 DataMatrix will not replace other GS1 system symbologies. Existing applications that are satisfactorily utilising EAN/UPC symbols, ITF-14 symbols, GS1-128 symbols, GS1 DataBar symbols, or Composite symbols should continue to use them.

When using GS1 DataMatrix symbols to encode the Global Trade Item Number (GTIN), any required additional data SHOULD be included within the same symbol.

- ✓ **Note:** Scanning systems that need to read GS1 DataMatrix symbols must be 2D imaging scanners and be appropriately programmed to read the GS1 system version of Data Matrix or ECC 200.

5.7.3.7 Human readable interpretation of GS1 DataMatrix symbols

For human readable interpretation rules see section [4.14.14.14.14](#). For HRI rules specific to regulated healthcare retail consumer trade items, see section [4.14.14.14.14.1](#).

~~For GS1 DataMatrix symbols encoding large amounts of data, it may not be practical to display all the data in human readable interpretation form. Even if there is space to show it in this form, it may not be practical to key enter that much data. In these instances, some of the data may be omitted from the human readable interpretation. However, primary identification data (GS1 system keys), such as the GTIN, must always be shown. Application specifications may provide additional guidance on human readable interpretation.~~

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5.8 Composite barcodes

5.8.1 Composite symbology introduction

The Composite symbology integrates both a GS1 system linear symbol and a 2D Composite Component as a single symbology. There are three types of Composite symbols A, B and C, each with different encoding rules. The encoder model is designed to automatically select the appropriate type and optimise.

The linear component encodes the item's primary identification. The adjacent 2D Composite Component encodes supplementary data, such as a batch number and expiration date. The Composite symbol always includes a linear component so that the primary identification is readable by all scanning technologies. The Composite symbol always includes a multi-row 2D Composite Component that can be read with linear- and area-CCD scanners, and with linear and rastering laser scanners.

The Composite symbology is described in the *Association for Automatic Identification and Mobility AIM ITS 99-002 - International Symbology Specification - Composite Symbology*.

5.8.1.1 Composite symbology characteristics

The characteristics of the Composite symbology are:

- Encodable character set:
 - Both linear and 2D components encode a subset of *ISO/IEC 646*. Refer to [Figure 7.11-1](#) for the allowed encodable character set.
 - The [Function 1 Symbol Character](#), [function character FNC1](#) and a Symbol Separator character.
- Symbol character structure: Various (n,k) symbol characters are used in accordance with the underlying symbology of the selected linear and 2D Composite Components of the symbol.
- Code type:
 - Linear component: continuous, linear barcode symbology.

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- 2D Composite Component: continuous, multi-row barcode symbology.
- Maximum numeric data capacity:
 - Linear component:
 - GS1-128 symbol: up to 48 digits.
 - EAN/UPC symbol: 8, 12, or 13 digits.
 - GS1 DataBar Expanded symbol: up to 74 digits.
 - Other GS1 DataBar symbols: 16 digits.
 - 2D Composite Component:
 - CC-A: up to 56 digits.
 - CC-B: up to 338 digits.
 - CC-C: up to 2,361 digit.
- Error detection and correction:
 - Linear component: a modulo check value for error detection.
 - 2D Composite Component: a fixed or variable number of Reed-Solomon error correction codewords, depending upon the specific 2D Composite Component.
- Character self-checking.
- Bi-directionally decodable.

5.8.1.2 Additional features

The following is a summary of additional Composite symbology features:

- Data compaction: The 2D Composite Components utilise a bit-oriented compaction mode designed to encode data efficiently using [GS1 Application Identifiers \(AIs\)](#).
- Component linkage: The 2D Composite Component of each Composite symbol contains a linkage flag, which indicates to the reader that no data shall be transmitted unless the associated linear component is also scanned and decoded. All linear components except EAN/UPC symbols also contain an explicit linkage flag.
- GS1-128 symbol emulation: Readers set to the GS1-128 symbol emulation mode transmit the data encoded within the Composite symbol as if the data were encoded in one or more GS1-128 symbols.
- A symbol separator character: A flag character to support future applications that instructs the reader to terminate transmission of the message at that point and to transmit the remaining data as a separate message
- 2D Composite Component escape mechanism: A mechanism to support future GS1 system applications that require characters beyond the *ISO/IEC 646* character subset defined for [GS1 Application Identifier \(AI\) element string data](#) (see [Figure 7.11-1](#)~~Figure 7.11-1~~[Figure 7.11-1](#)).

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5.8.2 Symbol structure

Each Composite symbol consists of a linear component and a multi-row 2D Composite Component. The 2D Composite Component is printed above the linear component. The two components are separated by a separator pattern. Up to 3X of light space is permitted between the separator pattern and 2D Composite Component to facilitate printing the two components separately; however, if the two components are printed at one time, the nominal alignment is followed as shown in the figure below.

Figure 5.8.2-1. GS1 DataBar Limited Composite symbol with CC-A



(01)13112345678906(17)010615(10)A123456

As an option, the data title (see section 3.2) may be associated with the data instead of using AIs. The figure below shows the expiration date and lot number identified with text. This can be compared with Figure 5.8.2-1, where the same data is shown using the all-AI format.

Figure 5.8.3-1. The human readable interpretation and non-HRI text



For Composite symbols encoding a large amount of data, it may not be practical to display all the data in human-readable interpretation form or, even if there is space to show it in this form, it may not be practical to key-enter that much data. In these instances, some of the data may be omitted from the human-readable interpretation. However, primary identification data such as the Global Trade Item Number (GTIN) and SSCC must always be shown. Application specifications provide guidance on human-readable interpretation.

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5.8.4 Data transmission and symbology identifier prefixes

5.8.4.1 Default transmission mode

The GS1 system requires the use of symbology identifiers. Composite symbols are normally transmitted using symbology identifier prefix "je0," with the data from the 2D Composite Component directly appended to that of the linear component. For example, a Composite symbol encoding (01)10012345678902(10)ABC123 produces the data string "je0011001234567890210ABC123" (note that the symbology identifier prefix "je0" is different from the symbology identifier prefix "JE0," which has an uppercase "E" and is used for standard EAN/UPC symbols). However, readers have an option to transmit only the linear component data and ignore the 2D Composite Component.

Data transmission follows the same principles that apply to the concatenation of GS1 Application Identifier (AI) element strings from GS1-128 symbols. If the linear component data ends with a variable length AI element string, [the control character an ASCII 29 character <GS> \(ASCII value 29 \(decimal\), 1D \(hexadecimal\)\)](#) is inserted between it and the first character of the data from the 2D Composite Component.

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5.8.4.2 GS1-128 Symbol transmission mode

Readers also have an option for GS1-128 symbol emulation mode. This mode emulates the GS1-128 symbology for data transmission. It can be used for applications programmed for GS1-128 symbols but not yet programmed to recognise the symbology identifier prefix "je0." The symbology identifier for GS1-128 symbol emulation mode is "JC1." Composite symbols that exceed 48 data characters are transmitted as two or more messages so as not to exceed the maximum GS1-128 symbol message length. Each of the messages has a symbology identifier prefix of "JC1" and does not exceed 48 data characters. The messages are split at boundaries between element strings. This mode is inferior to the normal transmission mode as message integrity may be lost when a message is split into multiple messages.

- ✔ **Note:** When GS1-128 emulation option is enabled in the reader, each data packet (except the data from an EAN/UPC component) SHALL be prefixed with a symbology identifier of "JC1". When transmitting data from GS1 Composite symbols, two separate transmissions from the reader are required. The data from the EAN/UPC component is prefixed with a symbology identifier in accordance with symbology identifier "E". Modifier character values 1 and 2 SHALL NOT be used when transmitting data from GS1 DataBar symbols.

5.9.4.6 Advice for selecting the symbology

Any use of GS1 QR Code should comply with GS1 system global application standards and be restricted to those applications defined by the GS1 system for GS1 QR Code. GS1 QR Code will not replace other GS1 system symbologies. Existing applications that are satisfactorily utilising EAN/UPC symbols, ITF-14 symbols, GS1-128 symbols, GS1 DataBar symbols, GS1 DataMatrix or GS1 composite symbols should continue to use them.

Note: Scanning systems that need to read GS1 QR Code symbols must be 2D imaging scanners and be appropriately programmed to read the GS1 system versions of ISO/IEC 18004 QR Code 2005.

5.9.4.7 Human readable interpretation of GS1 QR Code symbols

For human readable interpretation rules see section [4.144.144.14](#).

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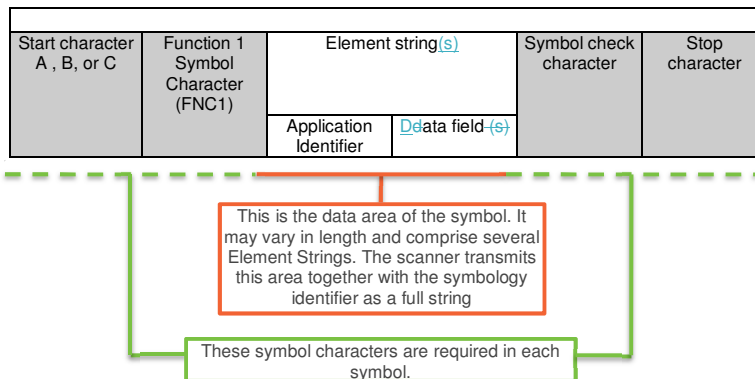
5.10 Appendix: Rules for encoding/decoding element strings in GS1 symbologies using GS1 Application Identifiers

5.10.1 The basic structure of GS1 barcodes using GS1 Application Identifiers and concatenation

All GS1 barcode symbologies that use GS1 Application Identifiers generally have a particular symbol character to indicate that the data is encoded according to the GS1 Application Identifier rules. For example, the GS1-128 symbology uses the Function 1 Symbol Character (FNC1) in the position immediately following the start character. This double-start character pattern is reserved for GS1 system applications worldwide and this makes it possible to distinguish GS1-128 barcodes from Code 128 symbols encoding extraneous non-GS1 barcodes data.

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Figure 5.10.1-1. Example GS1-128 barcode structure



All GS1 barcode symbologies that use GS1 Application Identifiers allow several element strings to be encoded in one barcode, a process called concatenation. Concatenation is advantageous because it means that the symbol's double start, symbol check and stop characters symbology elements are only needed once, and the space required for the symbol is smaller than when separate barcodes are used to encode each element string. It also improves scanning accuracy, allowing for single scanning rather than multiple scanning. The various element strings are transmitted from the barcode reader as a single full string.

The various element strings, which are transmitted from concatenated barcodes, have to be analysed and processed. All element strings need to be delimited separated by a separator character unless they have a predefined length or appear at the end of the symbol (encoded immediately

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before the symbol check character). All predefined length element strings are contained in Figure 5.10.1-2. To simplify this procedure and reduce the symbol size, the lengths of some element strings are pre-defined (see Figure 5.10.1-2 Figure 5.10.1-2 Figure 5.10.1-2). Element strings that are not contained in Figure 5.10.1-2 and that do not appear at the end of the symbol (encoded immediately before the symbol check character) must be delimited to separate them from the element string that follows.

The ~~delimiter~~ separator character SHALL be ~~either the Function 1 Symbol Character in GS1-128 symbology, GS1 DataBar Expanded Versions and GS1 Composite symbology. The delimiter in GS1 DataMatrix SHOULD be a Function 1 Symbol Character but may also be the character <GS>, known as Group Separator (FNC1), or the control character <GS> (ASCII value 29). The delimiter in (decimal), 1D (hexadecimal)), or, in the case of GS1 QR Code SHALL be symbology, the control character <GS>.~~

> or the character '%' (ASCII value 37 (decimal), 25 (hexadecimal)). Figure 5.10.1-2 contains all element strings that have a pre-defined length and, therefore, SHOULD not be terminated by a ~~delimiter~~ separator character. The ~~delimiter or separator character~~ SHALL be a Function 1 Symbol Character in GS1-128 symbology, GS1 DataBar Expanded Versions and GS1 Composite symbology. The delimiter in GS1 DataMatrix and SHOULD be a Function 1 Symbol Character but may also be the character <GS>, known as Group Separator (ASCII value 29). The delimiter in GS1 QR Code SHALL be the character <GS> in GS1 DataMatrix symbology and GS1 QR Code symbology.

Figure 5.10.1-2 Figure 5.10.1-2 Figure 5.10.1-2 contains all element strings Application Identifiers that have a predefined length and, therefore, SHOULD not be terminated by a ~~delimiter~~ separator character do not require a Function 1 Symbol Character (FNC1) separator.

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Figure 5.10.1-2. Element strings with pre-defined length using GS1 Application Identifiers

| First two digits of the Application Identifier | Number of characters (Application Identifier and data field) |
|--|--|
| 00 | 20 |
| 01 | 16 |
| 02 | 16 |
| (03) | 16 |
| (04) | 18 |
| 11 | 8 |
| 12 | 8 |
| 13 | 8 |
| (14) | 8 |
| 15 | 8 |
| 16 | 8 |
| 17 | 8 |
| (18) | 8 |
| (19) | 8 |
| 20 | 4 |
| 31 | 10 |
| 32 | 10 |
| 33 | 10 |
| 34 | 10 |
| 35 | 10 |
| 36 | 10 |
| 41 | 16 |

Note: ~~Figure 5.10.1-2~~~~Figure 5.10.1-2~~~~Figure 5.10.1-2~~ is limited to the listed numbers and will remain unchanged. Those numbers in parentheses are not yet assigned. GS1 Application Identifiers starting with two digits that are not included in ~~Figure 5.10.1-2~~~~Figure 5.10.1-2~~~~Figure 5.10.1-2~~ have a variable length even if the definition of the GS1 Application Identifier specifies a fixed length data field.

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5.10.2 Concatenation

5.10.2.1 Pre-defined length element strings

Concatenated element strings constructed from GS1 Application Identifiers with a pre-defined length ~~SHOULD not use~~~~do not require~~ a separator character following the element string of predefined length. Each element string is immediately followed by either the next GS1 Application Identifier or the symbol check character and stop character.

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For example, concatenation of net weight (4.00 kilograms) with the associated Global Trade Item Number (GTIN) 95012345678903 ~~SHOULD not include~~~~does not require~~ the use of a separator character.

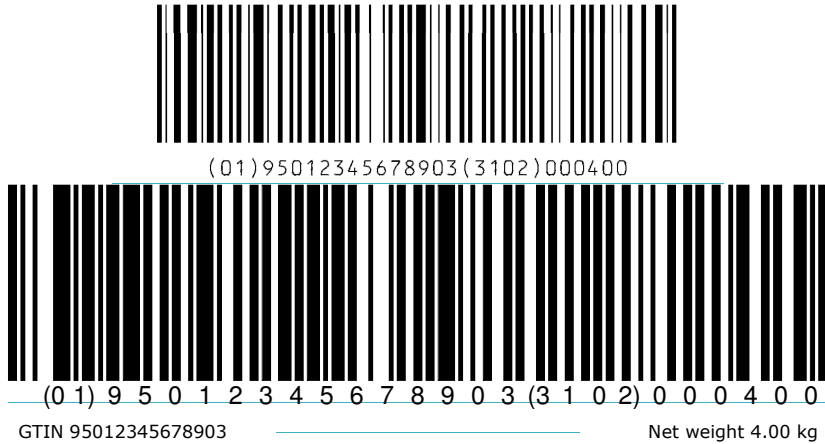
- (01) has a pre-defined element string length of 16 digits.
- (31nn) has a pre-defined element string length of 10 digits.

Figure 5.10.2.1-1. Data encoded in two GS1-128 symbols

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Figure 5.10.2.1-2. Data encoded in one concatenated GS1-128 symbol



5.10.2.2 Non-predefined length (variable length) element data strings

An element string that does not start with two characters defined in figure 5.10.1-2 SHALL be terminated by a separator character, unless it is the last element string to be encoded, when a separator character SHOULD not be used. Concatenating element strings of variable length, including all Application Identifiers that do not start with two characters contained in figure 5.10.1-2, involves the use of a separator character. The separator character used is the Function 1 Symbol Character (FNC1). It is placed immediately after the last symbol character of a non-predefined length (variable length) element data string and is followed by the GS1 Application Identifier of the next element string. The separator character used is either the Function 1 Symbol Character (FNC1) or the control character <GS> (ASCII value 29 (decimal), 1D (hexadecimal)), and it is always represented in the transmitted message by the character <GS> (ASCII value 29 (decimal), 1D (hexadecimal)). If the element string is the last to be encoded, it is followed by the Symbol Check and stop characters and not the FNC1 separator character.

For example, concatenation of price per unit of measure (365 currency units) and batch number (123456) requires the MUST use of a separator character immediately after the price per unit of measure.

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Figure 5.10.2.2-1. Data encoded in two GS1-128 symbols

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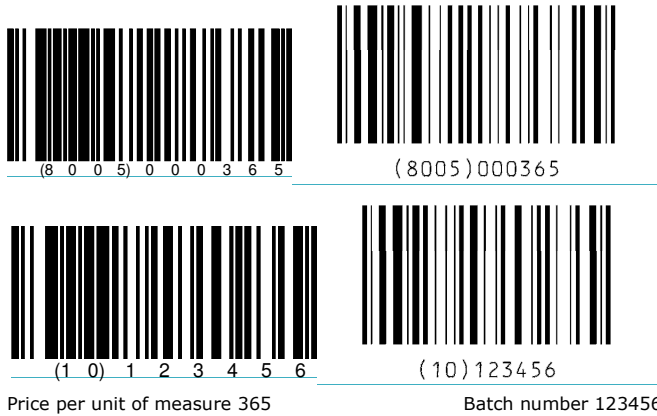


Figure 5.10.2.2-2. Data encoded in one concatenated GS1-128 symbol

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Note: The FNC1 is not shown in human readable interpretation.

5.10.2.3 Other considerations when using concatenation

Concatenation is an effective means for presenting multiple element strings in a single barcode and is used to conserve label space and optimise scanning operations when permitted by the application standard (e.g., concatenation SHALL not be used with the GS1-128 barcode containing the SSCC on cartons or outer cases). SSCC concatenation may be used on pallets providing the label size used permits printing of the barcode with the correct specifications at or above the target X-dimension in GS1 system symbol specification table 5.

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When concatenating a mixture of pre-defined length and variable length and other element strings, arranging the pre-defined element strings SHOULD appear together before ahead of SHOULD appear before the variable length other element strings. This usually results in a shorter linear barcode.

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The **FNC1** separator character appears in the decoded data string as **control character <GS>** (ASCII character value 29, (decimal), 1D (hexadecimal)), 7-bit character set ISO/IEC 646). A separator character SHOULD not be used at the end of the last element string encoded in a GS1 barcode, represented in a GS1 symbologies using GS1 Application Identifiers.

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Notwithstanding the above, the processing routine SHALL allow to tolerate a single separator character immediately following any entered-by-error-after-an element string, whether necessary or not, and process the data in accordance with section 7.8 Processing of data from a GS1 symbology using GS1 Application Identifiers, contained in Figure 5.10.1-2.

Figure 5.10.2.3-1. Example of GS1 DataBar Expanded Stacked barcode that uses concatenation



Concatenation may not be desirable in all circumstances (e.g., GS1 Logistics Labels are often constructed using multiple rows of barcode), in such cases the barcode containing the additional attribute data encoded using GS1 Application Identifiers SHOULD be printed in close proximity to the barcode containing the GS1 identification key.

Figure 5.10.2.3-2. Example of mixed GS1 symbologies (GTIN encoded in UPC-E, Best before date in Composite)



5.10.3 GS1 Application Identifiers with implied decimal point positions

Commented [CJ162]: WR16-410 new section

For all GS1 Application Identifiers with an implied decimal point position, the following rules apply:

For predefined length AIs

- For predefined length GS1 Application Identifiers with a data field length of 9 or less, the maximum number of decimal places is equal to the length of the AI data field as indicated in the format of the GS1 Application Identifier, minus 1. For example, for an AI with data format N8 the maximum number of decimal places is 7.
- For predefined length GS1 Application Identifiers with a length greater than 9, the maximum number of decimal places is 9. For example, for an AI with data format N12 the maximum number of decimal places is 9.

Example for predefined length AIs:

The data field format of AI (394n) is N4, so the maximum number of implied decimal places is 3.



7.8.1 General

Any GS1 symbology using GS1 Application Identifiers may represent several element strings in concatenated form (see section 5).

For processing as shown in figure 7.3-1, it is necessary to separate each element string, which is performed by the processing routine illustrated in figure 7.8-1.

7.8.2 Element strings with pre-defined lengths using **GS1 Application Identifiers**

Representation of more than one element string in a GS1 symbology using GS1 Application Identifiers may require the use of a separator character between the different element strings to mark their end. ~~When the data is encoded, this is normally the Function 1 Symbol Character (FNC1) or, in the case of some types of GS1 DataBar, is part of the symbology specification. For details, see section 5.~~

However, in order to enable printing of ~~shorter-smaller~~ barcodes, some element strings have been pre-defined in length, so that their end is determined, and a separator character SHOULD not be used and the FNC1 is not needed. These element strings are shown in the pre-defined table shown in section 5.10. ~~All other element strings, even if defined as fixed length in section 3, are not of predefined length and are formally variable length fields which require a separator character if followed by another element string.~~

A separator character SHOULD not be used at the end of the last element string represented in a barcode or for certain AI combinations defined by the symbology specification (e.g., some types of GS1 DataBar).

7.8.3 ~~The separator character and its value of the decoded separator character~~ **Function 1 Symbol Character (FNC1)**

In GS1-128 symbology: The Function 1 Symbol Character SHOULD be the separator character, and the control character <GS> (ASCII value 29 (decimal), 1D (hexadecimal)) may be an alternative.

In GS1 DataMatrix symbology: The Function 1 Symbol Character or the control character <GS> SHALL be the separator character.

In GS1 QR Code symbology: The control character <GS> or the character '%' (ASCII value 37 (decimal), 25 (hexadecimal)) SHALL be the separator character.

In GS1 DataBar and GS1 Composite symbology: The Function 1 Symbol Character SHALL be the separator character.

The value of the decoded separator character transmitted in the decoded data string is always control character <GS> (ASCII value 29 (decimal), 1D (hexadecimal)). It is important to note that some receiving systems may convert/interpret the control character <GS> as something other than ASCII value 29 (decimal), 1D (hexadecimal).

All element strings not included in the pre-defined table shown in section 5.10 MUST be separated by a separator character when followed by another element string in a single barcode.

When it is Only when used as a separator character is the Function 1 Symbol Character (FNC1) is transmitted in the decoded data string as <GS> (ASCII character 29, seven-bit character set ISO 646):

If <GS> is used as the separator character in GS1 DataMatrix or GS1 QR Code, its transmitted value will remain as <GS>. All element strings of variable length and those of fixed length not stated included in the pre-defined table shown in section 5.10 must MUST be delimited when followed by another element string in a single barcode.

The delimiter SHALL be a Function 1 Symbol Character in GS1-128 symbology, GS1 DataBar Expanded Versions and GS1 Composite symbology and SHOULD be a Function 1 Symbol Character in GS1 DataMatrix symbology and GS1 QR Code symbology. A delimiter SHOULD not be used is not required at the end of the last element string represented in a barcode or for certain AI combinations defined by the symbology specification (e.g., some types of GS1 DataBar).

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