GS1 in Europe


# Security Seal Factsheet

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# 1. Introduction

A new ruleset launched by Eurosystem encourage National Central Banks (NCBs) to add a security seal uniquely identified on the pallets sent from banknote printing sites to NCBs warehouses.

GS1 in Europe Cash Handling Work Group (GS1 in Europe CH WG) after having conversations in different European countries with their respective NCB, decided unanimously to lunch a recommendation for the uniquely identification of the security seal based on the GS1 standards.

**The recommendation launched by GS1 in Europe CH WG considered:**

- Security seal identification.

**The recommendation has the support of all GS1 Member Organizations (MOs) that are part of the Core Group in the GS1 in Europe CH WG:**

- GS1 France
- GS1 Germany
- GS1 Italy
- GS1 Poland
- GS1 Slovenia
- GS1 Spain
- GS1 Croatia
- GS1 Greece

# 2. Security seal identification

## 2.1 Introduction

**The aim is to provide a uniquely identification for a security seal.**

Following facts have been considered by GS1 in Europe CH WG in order to launch the recommendation:

- Currently, each pallet has a Serial Shipping Container Code (SSCC) that uniquely identifies each pallet.
- The goal of giving a unique identification to a security seal is to provide more security to the pallet, making a match between the SSCC with the security seals identifications located on the pallet regarding the information provided by the banknote printing site.
- An amount between two and eight security seals can be located on the pallet, depending on the country and if it is a half europallet or a "full" europallet.
- To avoid errors in manual reading of the security seal barcode, the code proposed to identify security seal must be different from the SSCC code.
- The code proposed should have a sequence of digits that uniquely identifies the cash printer house, the aim of the point is to avoid the possibility of duplication security seals codes by different banknote printing site.
- The security seal main purpose is to prevent counterfeiting or the alteration of the logistic units.

Regarding the commented considerations, GS1 in Europe CH WG contrasted with GS1 GO the recommendation of use of the GS1 Application Identifier Global Document Type Identifier (GDTI).
GDTI is a GS1 identification key that fits with all requirements of the Eurosystem ruleset and with all procedural necessities of main NCBs.

Example of a pallet that is sent from banknote printing site to a NCB warehouse:

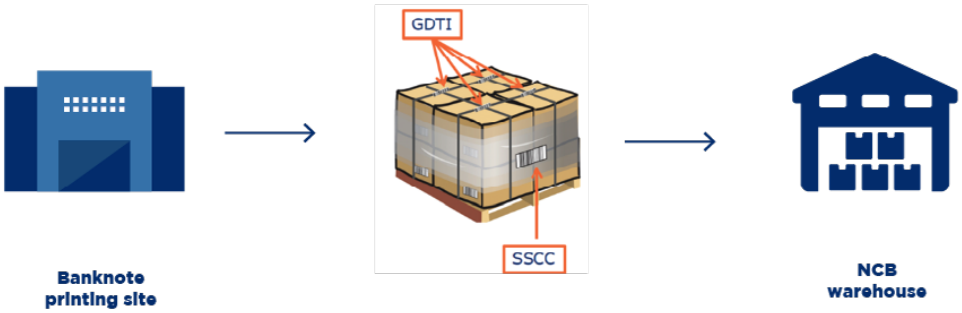



*Figure 1: Logistic unit and flow in cash handling supply chain*

## 2.2 The GS1 GDTI key

The GDTI is used to identify a document type with an optional serial number and one of its main objectives is to provide security along the different supply chains.
The GS1 Application Identifier (253) indicates that the GS1 Application Identifier data field contains the GDTI.

Format of the element string:

The GDTI is an identifier composed of different elements:

- GS1 Company Prefix has a fix length defined when the company was associated with GS1, the length depends on the necessity of the company of having different GTINs.
  The GS1 Company Prefix is public and can be found in https://www.gs1.org/services/verified-by-gs1
- Document type has a variable length depending on the GS1 Company Prefix length.
  [Document type length = 12 - Company Prefix length]
- Check digit is an important part of the GS1 coding, as it allows the complete elimination of code reading errors. It's based on GS1 Company Prefix + Document type and can be calculated on https://www.gs1.org/services/check-digit-calculator.
  The mathematical method for manually calculating the check digit can be consulted in the appendix 3.1.
- Serial component is the part of the GDTI that will allow creating a unique code for each document type, in this case for the security seal, the length can be from 1 alphanumerical character to 17 alphanumerical characters.
  The GS1 proposal and as agreed by NCB´s and the CH WG during the GS1 Regional forum in Athens 2023 the serial component will be composed of 6 numerical digits.

| GS1 Application Identifier | Global Document Type Identifier (GDTI) | | |
|---|---|---|---|
| | GS1 Company Prefix → ← Document Type | Check digit | Serial Component (optional) |
| 2 5 3 | $N_1$ $N_2$ $N_3$ $N_4$ $N_5$ $N_6$ $N_7$ $N_8$ $N_9$ $N_{10}$ $N_{11}$ $N_{12}$ | $N_{13}$ | $X_1$ ——— variable ———→ $X_{17}$ |

*Figure 2: GDTI Key identifier structure*

## 2.3 Example of GDTI identification number

Seal Security sent from banknote printing site to NCB

- GS1 Application Identifier: 253
- GS1 Company Prefix: 845678
- Document type: 000012
- Check digit: 9
- Serial component: 000001

Final code: (253)8456780000129000001

## 2.4 Data Carrier

A data carrier is a graphical representation of data in a machine-readable form, used to enable automatic reading of the element Strings.

For the capture of the GDTI key identifier the CH WG proposed the NCB the 2D barcode, the GS1 Data Matrix, as the data carrier to be printed on the seal.

The GS1 Data Matrix is the ISO/IEC recognized and standardized implementation of the use of Data Matrix and it is formed by adding FNC1 codeword in the first position of Data Matrix ECC 200 version.

It must be used so to achieve interoperable transmission of data between stakeholders' systems within the cash handling supply chain 1. The GS1 Data Matrix may be printed as a square or rectangular symbol made up of individual dots or squares. This representation is an ordered grid of dark and light dots bordered by a finder pattern. The finder pattern is partly used to specify the orientation and structure of the symbol. The size of these dots is known as the X-dimension.

GS1 Data Matrix is capable of encoding variable length data. Therefore, the size of the resulting symbol varies according to the amount of data encoded. The size of a GS1 Data Matrix is dependent upon the following factors:

- The amount and format (numeric or alphanumeric) of the encoded information*: numbers and characters are encoded in terms of bits, represented by dark or light "dots" or "modules" of an identical size. The larger the number of bits required, the larger the symbol will be.
- The size of the X-dimension
- The choice of form: square or rectangular

** The maximum amount of data that can be encoded in the GS1 Data Matrix is of 2335 alphanumerical characters or 3116 numbers (corresponding to the largest GS1 Data Matrix, 144 x 144 modules)*

It was agreed with NCBs to use the GS1 Data Matrix, with a square shape, to encode the GDTI identifier on the physical seal due to the next criteria:

- Data encoding capacity.
- Space restriction on the seal that limits the use of larger data carriers like the GS1-128 barcode or the QR code.
- Possibility of representing the data in a square or rectangular shape in order to comply with size limitations.

## 2.5 Data encoding and representation in GS1 Data Matrix

The encoding of data in the GS1 Data Matrix can be done using a variety of structures like ASCII, ISO/IEC 646, C40, Text, X12, EDIFACT and Base 256 but the simplest and the one mandated by the GS1 standards, is to encode data using the subset of ISO/IEC 646 (equivalent to ASCII table 256, see Appendix 4.2 ), since this character set is supported by almost all computer systems available around the world today.

[1] https://www.gs1.org/standards/gs1-datamatrix-guideline/25#1-Introduction-to-GS1-DataMatrix)

The encoded data must be previously structured in a GS1 element string following the next rules.

- By definition in ISO/IEC 16022 GS1 Data Matrix uses a special start sequence to differentiate GS1 Data Matrix from other ISO/IEC Data Matrix symbols. This is achieved by using the Function 1 Symbol Character (FNC1) in the first position of the data encoded. It enables scanners to process the information according to the GS1 System Rules.
- The FNC1 character symbol it is also used to separate concatenated application identifiers (AIs) of variable length[2].
- The brackets represented in the human readable information shall not be encoded in the elementstring.

Therefore, the GS1 element string for the previous example of the GDTI identifier would result as

**GS1 Element string: FNC12538456780000121000001**

Once encoded, the data must be captured in the GS1 Data Matrix data carrier. In this case, for the seal ID, the main restriction is the available physical space in the seal.

In first place, the minimum obligatory size of the GS1 Data Matrix is calculated so to respect the amount of data encoded for this case.

The number of digits is calculated taking into account that the FNC1 symbol counts as 2 digits, therefore the total number of digits encoded corresponds to 2 (FNC1) + 3 (AI GDTI) + 19 (Data)= 24 digits.


Once known the amount of data required to encode, the size of the GS1 Data Matrix is obtained from the following table, specified in the above mentioned GS1 Data Matrix guideline.

[2] https://www.gs1.org/standards/gs1-datamatrix-guideline/25#2-Encoding-data+2-2-GS1-element-strings)

| Symbol size (*) | | Data region- | | Mapping | Total | | Reed-Solomon | | Inter-leaved | Data capacity | | | Error | Max. Cor-rectable |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Matrix | Codewords | | Block | | | Num. | Alpha-num. | Byte | Correction | Codeword |
| Row | Col | Size | No. | Size | Data | Error | Data | Error | Blocks | Cap. | Cap. | Cap. | Overhead % | Error/ Erasure |
| 10 | 10 | 8x8 | 1 | 8x8 | 3 | 5 | 3 | 5 | 1 | 6 | 3 | 1 | 62.5 | 2/0 |
| 12 | 12 | 10x10 | 1 | 10x10 | 5 | 7 | 5 | 7 | 1 | 10 | 6 | 3 | 58.3 | 3/0 |
| 14 | 14 | 12x12 | 1 | 12x12 | 8 | 10 | 8 | 10 | 1 | 16 | 10 | 6 | 55.6 | 5/7 |
| 16 | 16 | 14x14 | 1 | 14x14 | 12 | 12 | 12 | 12 | 1 | 24 | 16 | 10 | 50 | 6/9 |
| 18 | 18 | 16x16 | 1 | 16x16 | 18 | 14 | 18 | 14 | 1 | 36 | 25 | 16 | 43.8 | 7/11 |
| 20 | 20 | 18x18 | 1 | 18x18 | 22 | 18 | 22 | 18 | 1 | 44 | 31 | 20 | 45 | 9/15 |
| 22 | 22 | 20x20 | 1 | 20x20 | 30 | 20 | 30 | 20 | 1 | 60 | 43 | 28 | 40 | 10/17 |
| 24 | 24 | 20x20 | 1 | 22x22 | 36 | 24 | 36 | 24 | 1 | 72 | 52 | 34 | 40 | 12/21 |
| 26 | 26 | 24x24 | 1 | 24x24 | 44 | 28 | 44 | 28 | 1 | 88 | 64 | 42 | 38.9 | 14/25 |
| 32 | 32 | 14x14 | 4 | 28x28 | 62 | 36 | 62 | 36 | 1 | 124 | 91 | 60 | 36.7 | 18/33 |
| 36 | 36 | 16x16 | 4 | 32x32 | 86 | 42 | 86 | 42 | 1 | 172 | 127 | 84 | 32.8 | 21/39 |
| 40 | 40 | 18x18 | 4 | 36x36 | 114 | 48 | 114 | 48 | 1 | 228 | 169 | 112 | 29.6 | 24/45 |
| 44 | 44 | 20x20 | 4 | 40x40 | 144 | 56 | 144 | 56 | 1 | 288 | 214 | 142 | 28 | 28/53 |
| 48 | 48 | 22x22 | 4 | 44x44 | 174 | 68 | 174 | 68 | 1 | 348 | 259 | 172 | 28.1 | 34/65 |
| 52 | 52 | 24x24 | 4 | 48x48 | 204 | 84 | 102 | 42 | 2 | 408 | 304 | 202 | 29.2 | 42/78 |
| 64 | 64 | 14x14 | 16 | 56x56 | 280 | 112 | 140 | 56 | 2 | 560 | 418 | 277 | 28.6 | 56/106 |
| 72 | 72 | 16x16 | 16 | 64x64 | 368 | 144 | 92 | 36 | 4 | 736 | 550 | 365 | 28.1 | 72/132 |
| 80 | 80 | 18x18 | 16 | 72x72 | 456 | 192 | 114 | 48 | 4 | 912 | 682 | 453 | 29.6 | 96/180 |
| 88 | 88 | 20x20 | 16 | 80x80 | 576 | 224 | 144 | 56 | 4 | 1152 | 862 | 573 | 28 | 112/212 |
| 96 | 96 | 22x22 | 16 | 88x88 | 696 | 272 | 174 | 68 | 4 | 1392 | 1042 | 693 | 28.1 | 136/260 |
| 104 | 104 | 24x24 | 16 | 96x96 | 816 | 336 | 136 | 56 | 6 | 1632 | 1222 | 813 | 29.2 | 168/318 |
| 120 | 120 | 18x18 | 36 | 108x108 | 1050 | 408 | 175 | 68 | 6 | 2100 | 1573 | 1047 | 28 | 204/390 |
| 132 | 132 | 20x20 | 36 | 120x120 | 1304 | 496 | 163 | 62 | 8 | 2608 | 1954 | 1301 | 27.6 | 248/472 |
| 144 | 144 | 22x22 | 36 | 132x132 | 1558 | 620 | 156 | 62 | 8(**) | 3116 | 2335 | 1556 | 28.5 | 310/590 |
| | | | | | | | 155 | 62 | 2(**) | | | | | |

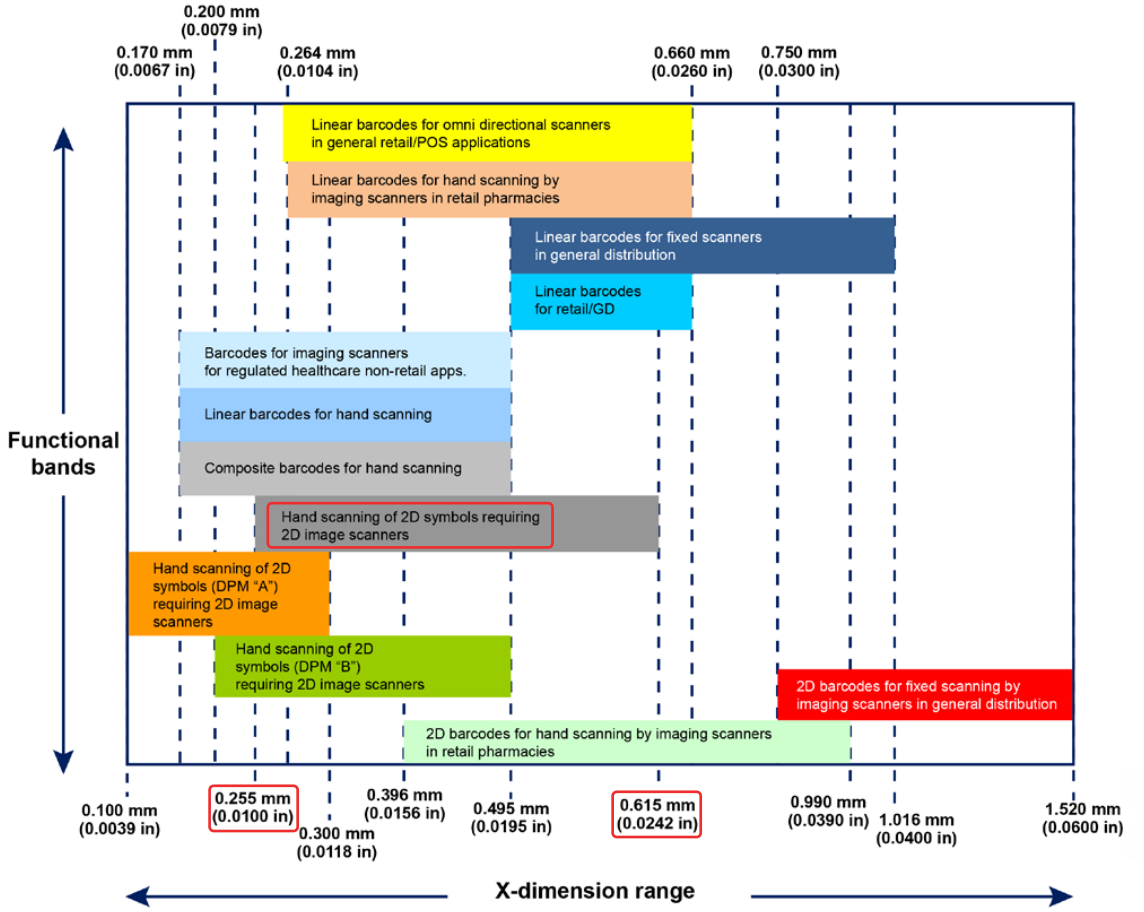
*Table 1: Formats for squared GS1 Data Matrix*

Following the example, hence the data encoding requirement, the data symbol size corresponds to the one immediately superior, in this case the 18 x 18 symbol size. *Important to take into consideration that this symbol size does not include the "Quiet Zones" or margins that the identifier requires for correct scanning, therefore the entire space required will be equivalent to a 20 x 20 modules symbol size.

The second variable to consider in the GS1 Data Matrix size is the X-dimension. For this scenario, based on the X-dimension ranges indicated in the GS1 General Specifications bands and on the verification performed of the first seal ID prototype the range of X-dimension is between 0.255mm and 0.615mm. Therefore, the resultant GS1 Data Matrix size will range between 5.1mm x 5.1mm and a 12.3mm x 12.3mm GS1 Data Matrix[3].

The final size of the GS1 Data Matrix will be of course limited by the available space in the seal but it is recommended to print the largest size possible to increase scanning reliability and performance. It is always recommended to perform a seals' barcode quality verification control in selected printing phases according to the ISO/IEC 15215 and GS1 standards to achieve optimum scan ability in different environments and scanners which fully guarantees the correct data capture operations within the cash handling supply chain.

[3] This is in accordance to the '5.12.3.9 Symbol specification table 9 - GS1 keys GDTI, GRAI, GIAI and GLN' in the GS1 General Specifications 2024




## 2.6 Alternative rectangular GS1 Data Matrix for different type of seals

Regarding other possible type of seals with a different space availability the GS1 Data Matrix can have a rectangular shape form. The rules for electing the size are the same as explained previously, following the dimensions specified in the table specific for rectangular GS1 Data Matrix.

Assuming the same data encoding requirement of 24 numerical digits the minimum size for a rectangular GS1 Data Matrix is of 12 x 26 modules (without including the quiet zones).

| Symbol size (*) | | Data region- | | Mapping | Total | | Reed-Solomon | | Inter-leaved | Data capacity | | | Error | Max. Cor-rectable |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Matrix | Codewords | | Block | | | Num. | Alpha-num. | Byte | Correction | Codeword |
| Row | Col | Size | No. | Size | Data | Error | Data | Error | Blocks | Cap. | Cap. | Cap. | Overhead % | Error/ Erasure |
| 8 | 18 | 6x16 | 1 | 6x16 | 5 | 7 | 5 | 7 | 1 | 10 | 6 | 3 | 58.3 | 3/+ |
| 8 | 32 | 6x14 | 2 | 6x28 | 10 | 11 | 10 | 11 | 1 | 20 | 13 | 8 | 52.4 | 5/+ |
| 12 | 26 | 10x24 | 1 | 10x24 | 16 | 14 | 16 | 14 | 1 | 32 | 22 | 14 | 46.7 | 57/11 |
| 12 | 36 | 10x16 | 2 | 10x32 | 22 | 18 | 22 | 18 | 1 | 44 | 31 | 20 | 45.0 | 9/15 |
| 16 | 36 | 14x16 | 2 | 14x32 | 32 | 24 | 32 | 24 | 1 | 64 | 46 | 30 | 42.9 | 12/21 |
| 16 | 48 | 14x22 | 2 | 14x44 | 49 | 28 | 49 | 28 | 1 | 98 | 72 | 47 | 36.4 | 14/25 |

*Table 2: Formats for rectangular GS1 Data Matrix*

Again, assuming the same X-dimensions as for the square version the size of the data carrier would range between 3.06mm x 6.63mm and a 7.38mm x 15.99mm GS1 Data Matrix.

The final size of the GS1 Data Matrix will be of course limited by the available space in the seal but it is recommended to print the largest size possible to increase scanning reliability and performance.

## 2.7 Human Readable Information (HRI)

The purpose of the Human Readable Information (HRI) is to act as back up, in case the GS1 Data Matrix fails to be scanned, the operator can read and manually introduce the GDTI identifier in the software managing system.

The main recommendations from GS1 in Europe CH WG are related to placement, font and legibility.

- When a barcode encodes a GS1 identification key the HRI should be placed adjacent to the barcode, in this case due to the shape of the seal, above or below the GS1 Data Matrix symbol.
- The Application Identifier for GDTI shall be surrounded by parentheses (253).
- The HRI should not be printed within the “Quiet Zones” of the GS1 Data Matrix.
- The font size should be at least 2 millimeters in height.
- Bold, italics, light or narrow versions of a font should not be used.

# 3. Appendix

## 3.1 Method for manually calculating the check digit

| ID Key Format | N1 | N2 | N3 | N4 | N5 | N6 | N7 | N8 | N9 | N10. | N11 | N12 | N13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number without check digit | 8 | 4 | 5 | 6 | 7 | 8 | 0 | 0 | 0 | 0 | 1 | 2 | - |
| Step 1: Multiply | x | x | x | x | x | x | x | x | x | x | x | x | - |
| by | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | 1 | 3 | - |
| Step 2: Add results 2 | = | = | = | = | = | = | = | = | = | = | = | = | - |
| To create sum | 8 | 12 | 5 | 18 | 7 | 24 | 0 | 0 | 0 | 0 | 1 | 6 | =81 |
| Step 3: Subtract the sum from nearest equal or higher multiple of ten = 90 – 81 = 9 (Check Digit) | | | | | | | | | | | | | |
| Number with Check Digit | 8 | 4 | 5 | 6 | 7 | 8 | 0 | 0 | 0 | 0 | 1 | 2 | 9 |

*Table 4: Mathematical calculus for the check digit*

## 3.2 ASCII character set table 256 subset of ISO/IEC 64

| Graphic Symbol | Name | Coded Representation | Graphic Symbol | Name | Coded Representation |
|---|---|---|---|---|---|
| ! | Exclamation mark | 2/1 | > | Greater-than sign | 3/14 |
| “ | Quotation mark | 2/2 | ? | Question mark | 3/15 |
| % | Percent sign | 2/5 | A | Capital letter A | 4/1 |
| & | Ampersand | 2/6 | B | Capital letter B | 4/2 |
| ´ | Apostrophe | 2/7 | C | Capital letter C | 4/3 |
| ( | Left parenthesis | 2/8 | D | Capital letter D | 4/4 |
| ) | Right parenthesis | 2/9 | E | Capital letter E | 4/5 |
| * | Asterisk | 2/10 | F | Capital letter F | 4/6 |
| + | Plus sign | 2/11 | G | Capital letter G | 4/7 |
| , | Comma | 2/12 | H | Capital letter H | 4/8 |
| - | Hyphen/Minus | 2/13 | I | Capital letter I | 4/9 |
| . | Full stop | 2/14 | J | Capital letter J | 4/10 |
| / | Solidus | 2/15 | K | Capital letter K | 4/11 |
| 0 | Digit zero | 3/0 | L | Capital letter L | 4/12 |
| 1 | Digit one | 3/1 | M | Capital letter M | 4/13 |
| 2 | Digit  two | 3/2 | N | Capital letter N | 4/14 |
| 3 | Digit three | 3/3 | O | Capital letter O | 4/15 |
| 4 | Digit four | 3/4 | P | Capital letter P | 5/0 |
| 5 | Digit five | 3/5 | Q | Capital letter Q | 5/1 |
| 6 | Digit six | 3/6 | R | Capital letter R | 5/2 |
| 7 | Digit seven | 3/7 | S | Capital letter S | 5/3 |
| 8 | Digit eight | 3/8 | T | Capital letter T | 5/4 |
| 9 | Digit nine | 3/9 | U | Capital letter U | 5/5 |
| : | Colon | 3/10 | V | Capital letter V | 5/6 |
| ; | Semicolon | 3/11 | W | Capital letter W | 5/7 |
| < | Less-than sign | 3/12 | X | Capital letter X | 5/8 |
| = | Equals sign | 3/13 | Y | Capital letter Y | 5/9 |
| Z | Capital letter Z | 5/10 | m | Small letter m | 6/13 |
| _ | Low line | 5/15 | n | Small letter n | 6/14 |
| a | Small letter a | 6/1 | o | Small letter o | 6/15 |
| b | Small letter b | 6/2 | p | Small letter p | 7/0 |
| c | Small letter c | 6/3 | q | Small letter q | 7/1 |
| d | Small letter d | 6/4 | r | Small letter r | 7/2 |
| e | Small letter e | 6/5 | s | Small letter s | 7/3 |
| f | Small letter f | 6/6 | t | Small letter t | 7/4 |
| g | Small letter g | 6/7 | u | Small letter u | 7/5 |
| h | Small letter h | 6/8 | v | Small letter v | 7/6 |
| i | Small letter i | 6/9 | w | Small letter w | 7/7 |
| j | Small letter j | 6/10 | x | Small letter x | 7/8 |
| k | Small letter k | 6/11 | y | Small letter y | 7/9 |
| i | Small letter l | 6/12 | z | Capital letter z | 7/10 |

*Table 5: Accepted characters for GDTI serial string*

## 3.3 Samples for different type of seal ID

The first two samples show the squared and rectangular GS1 Data Matrix for the hard plastic seal type.


The next samples correspond to the stripped seal type, with the two types of GS1 Data Matrix, squared and rectangular format.

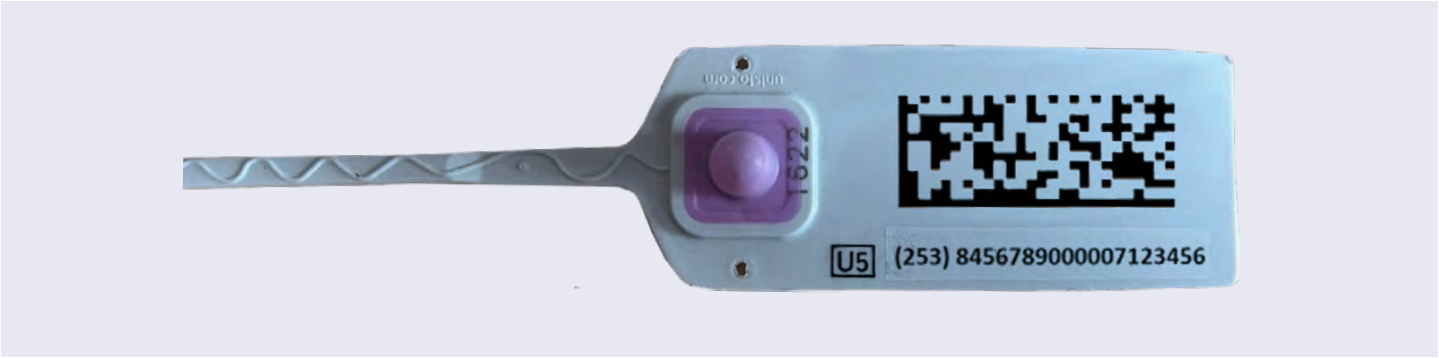



*Figure 6 : Stripped seal with rectangular GS1 Data Matrix*

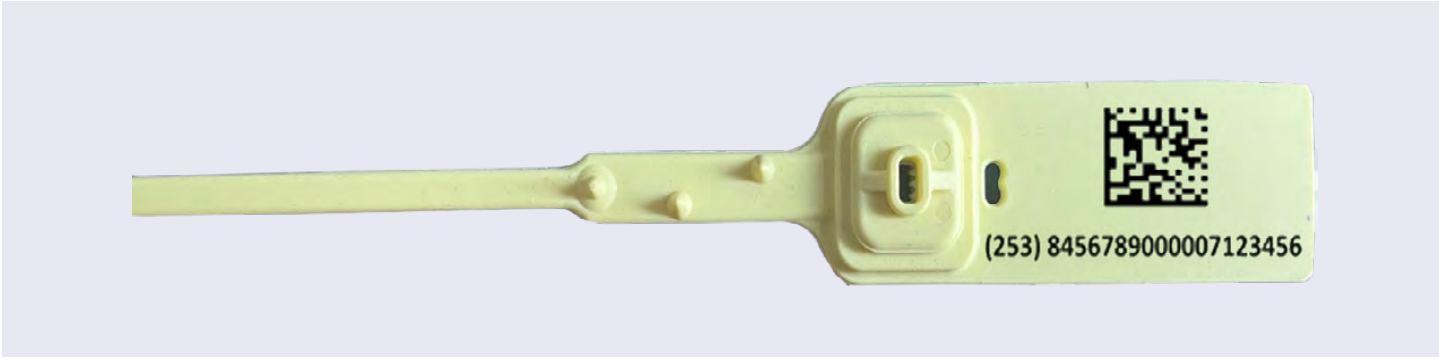



*Figure 7 : Stripped seal with squared GS1 Data Matrix*

# About GS1 in Europe

GS1 in Europe is a non-profit organisation uniting 49 member countries and representing over 500,000 companies across Europe. As part of the global GS1 network, we provide a system of internationally recognised standards that enable seamless identification of products, locations, entities, and assets. Our mission is to create a common language for business, fostering efficiency, transparency, and innovation across industries. Together, we drive collaboration and support businesses in Europe.

## Do you need help?

GS1 in Europe Member Organisations can support you further in implementing GS1 standards.

Connect with your local GS1 Member Organisation through **gs1.eu/gs1-in-europe-member-organisations**

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