GS1 DIY Self-Learning Materials

GS1 Barcode Symbol Specifications

GS1 Malaysia Berhad

GS1 Malaysia

What to expect from this DIY Self-Learning Material

1. Understand what a barcode is and its place in a supply chain
2. Find out about the different types of GS1 Barcode symbols
3. The specifications for each type of barcode symbol
4. Guidelines on how to label your products, trade items and logistic units.

What is a Barcode?

What is a Barcode? (Also known as a Data Carrier)

A series of dark bars/dots and light spaces on a light background.

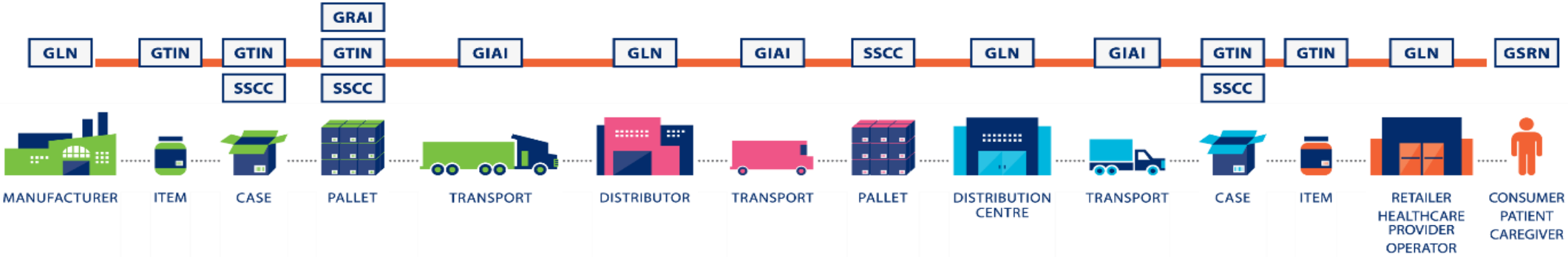
Each dark bar/dot and light space arrangement represents a number or character !

Why Use a Barcode?

Fast and accurate capture of information into a computerised system, with little to no human error.

IDENTIFY: GS1 Standards for Identification

GLN Global Location Number **GTIN** Global Trade Item Number **SSCC** Serial Shipping Container Code **GRAI** Global Returnable Asset Identifier **GIAI** Global Individual Asset Identifier **GSRN** Global Service Relation Number



CAPTURE: GS1 Standards for Barcodes & EPC/RFID

GS1 BARCODES

EAN/UPC

GS1-128

ITF-14

GS1 DataBar

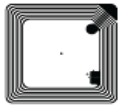
GS1 DataMatrix

GS1 QR Code

GS1 Composite Barcode

GS1 EPC/RFID

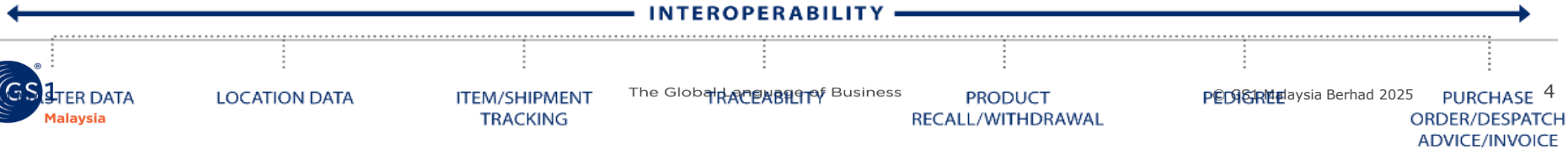
EPC HF Gen 2



EPC UHF Gen 2

SHARE: GS1 Standards for Data Exchange

MASTER DATA Global Data Synchronisation Network (GDSN) **TRANSACTIONAL DATA** eCom (EDI) **Event Data** EPC Information Services (EPCIS)



GS1 Barcode Symbologies

Common GS1 Barcode Symbols for Products

EAN-13

Most common symbol used for product Identification

EAN-8

Symbol for products with small form factor

UPC-A

Older symbol for product identification, US & Canada

UPC-E

Older symbol for small products, all numbers issued

Common GS1 Barcode Symbols for Cartons

ITF-14

Specially optimised for printing on rough or corrugated surfaces. Only for basic carton identification

GS1-128

Data-rich GS1 barcode symbol that can encode GTIN, batch/lot number, expiry date, serial number and more

GS1 Barcode Symbols for Track & Trace (Healthcare, high-value, baby-care, etc.)

GS1 2D Datamatrix

Data-rich GS1 2D barcode symbol that can encode a lot of data in a small space and comes with built-in error correction

GS1 QR Code

Data-rich GS1 2D barcode symbol, a lot of data in a small space & comes with built-in error correction, can encode logograms more efficiently

Reading GS1 Barcodes

Bar Code Scanner / Reader

Infrared laser scanner

Camera-based scanner

Data carrier

Linear barcode

2-D barcode

Barcode Symbol Size

The size of the bar code is known as magnification.

Magnification can vary within certain limits. If a bar code is not within these limits, it may not scan. Any reduction in magnification below the nominal size (100%) may reduce reliability. Reliability of scanning is always enhanced by selecting a magnification higher than the theoretical minimum.

Manufacturers should also consult their printer before deciding how large a bar code they will have on their pack. Until printability tests have been run the pack material concerned, it is not possible to say how large the bar code should be.

EAN-13

The nominal size of a 100% EAN-13 digit bar code symbol including the right and left light margin area is 37.29mm wide and 25.93mm high. The bar code symbol must be in the range of 80% to 200%.

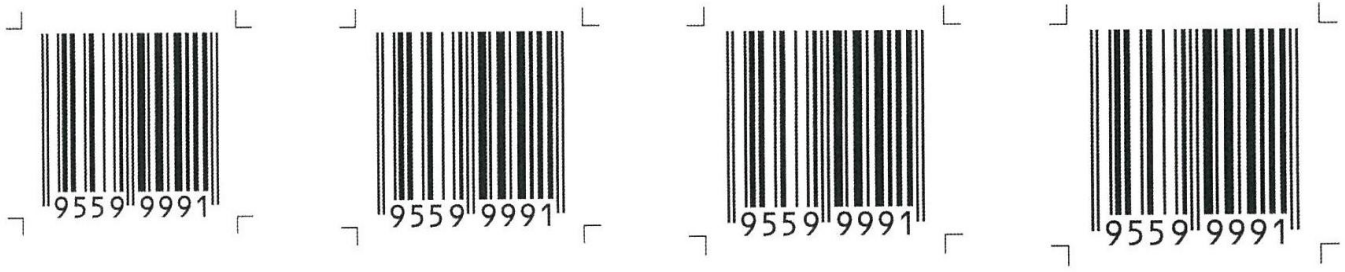
85% 90% 95% 100%

Barcode Symbol Size

EAN-8

EAN-8 digit bar code symbol is another option if the design of the pack or label genuinely and reasonably precludes the printing of a standard EAN-13 digit bar code symbol. The general rule is that the printable area should not be more than 8,000mm^2 or the product is cylindrical with a diameter less than 30mm. The nominal size of a 100% EAN-8 digit bar code symbol including the right and left right margin area is 26.73mm wide and 21.31mm high. The bar code symbol can be printed as small as 80%.

Due to the limited number of GTIN-8 digit available, it is only allocated if deemed absolutely necessary. When applying for a GTIN-8 digit, a sample label or a copy of the actual size of the artwork should be provided.



85% 90% 95% 100%

EAN-13 Symbol Structure

Light Margin

Human Readable Interpretation (HRI)

Other versions

Helps to ensure sufficient Light Margin

Barcode Symbol Dimensions for EAN-13 and EAN-8 Barcodes

Dimensions of GS1 Bar Codes (mm)						
Mag. Factor	EAN-13			EAN-8		
	Width not including LM	Width including LM	Height including Interp.	Width not including LM	Width including LM	Height including Interp.
0.80	25.08	29.83	20.74	17.69	21.38	17.05
0.85	26.65	31.70	22.04	18.79	22.72	18.11
0.90	28.22	33.56	23.34	19.90	24.06	19.18
0.95	29.78	35.43	24.63	21.00	25.39	20.24
1.00	**31.35**	**37.29**	**25.93**	**22.11**	**26.73**	**21.31**
1.05	32.92	39.15	27.23	23.22	28.07	22.38
1.10	34.49	41.02	28.52	24.32	29.40	23.44
1.15	36.05	42.88	29.82	25.43	30.74	24.51
1.20	37.62	44.75	31.12	26.53	32.08	25.57
1.25	39.19	46.61	32.41	27.64	33.41	26.64
1.30	40.76	48.48	33.71	28.74	34.75	27.70
1.35	42.32	50.34	35.01	29.85	36.09	28.77
1.40	43.89	52.21	36.30	30.95	37.42	29.83
1.45	45.46	54.07	37.60	32.06	38.76	30.90
1.50	47.03	55.94	38.90	33.17	40.10	31.97
1.55	48.59	57.80	40.19	34.27	41.43	33.03
1.60	50.16	59.66	41.49	35.38	42.77	34.10
1.65	51.73	61.53	42.78	36.48	44.10	35.16
1.70	53.30	63.39	44.08	37.59	45.44	36.23
1.75	54.86	65.26	45.38	38.69	46.78	37.29
1.80	56.43	67.12	46.67	39.80	48.11	38.36
1.85	58.00	68.99	47.97	40.90	49.45	39.42
1.90	59.57	70.85	49.27	42.01	50.79	40.49
1.95	61.13	72.72	50.56	43.11	52.12	41.55
2.00	62.70	74.58	51.86	44.22	53.46	42.62

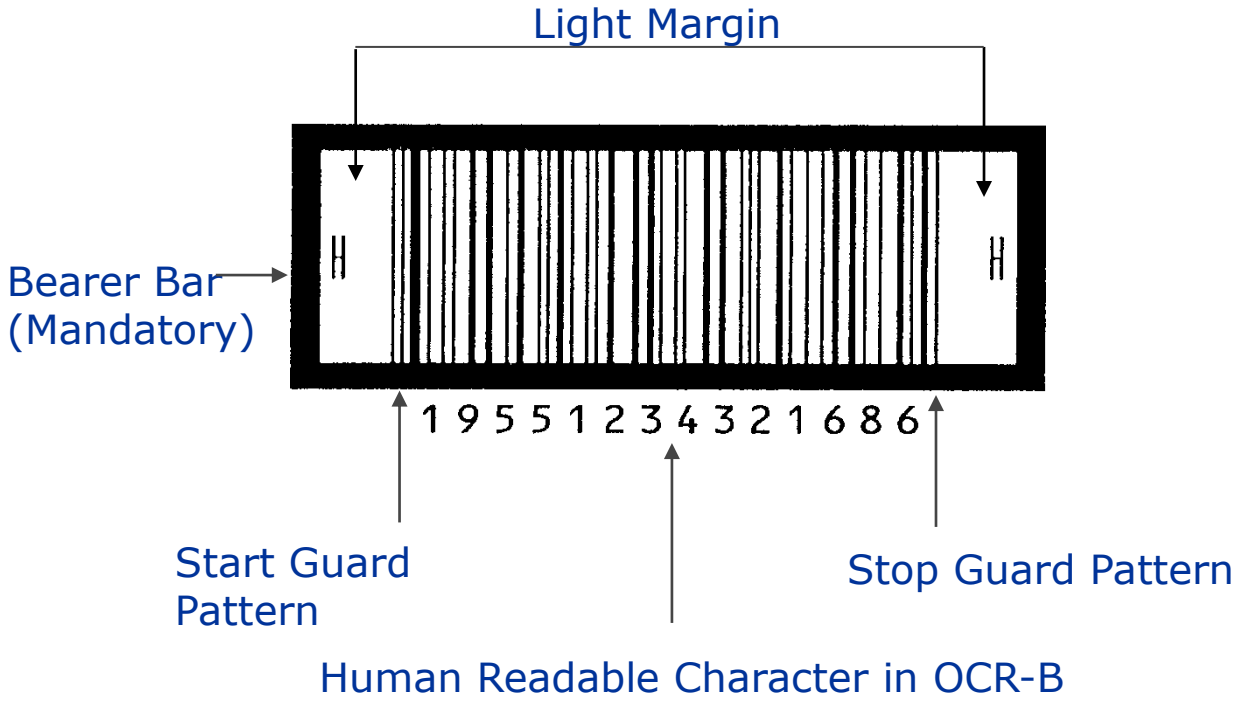
Note:

Mag. = Magnification (Size)

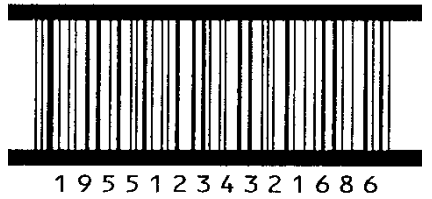
LM = Light Margins (Empty area before and after the bar code symbol)

Interp. = Human Readable Interpretation (The bar coded numbers below the bar code lines)

ITF-14 Symbol Structure



Other versions



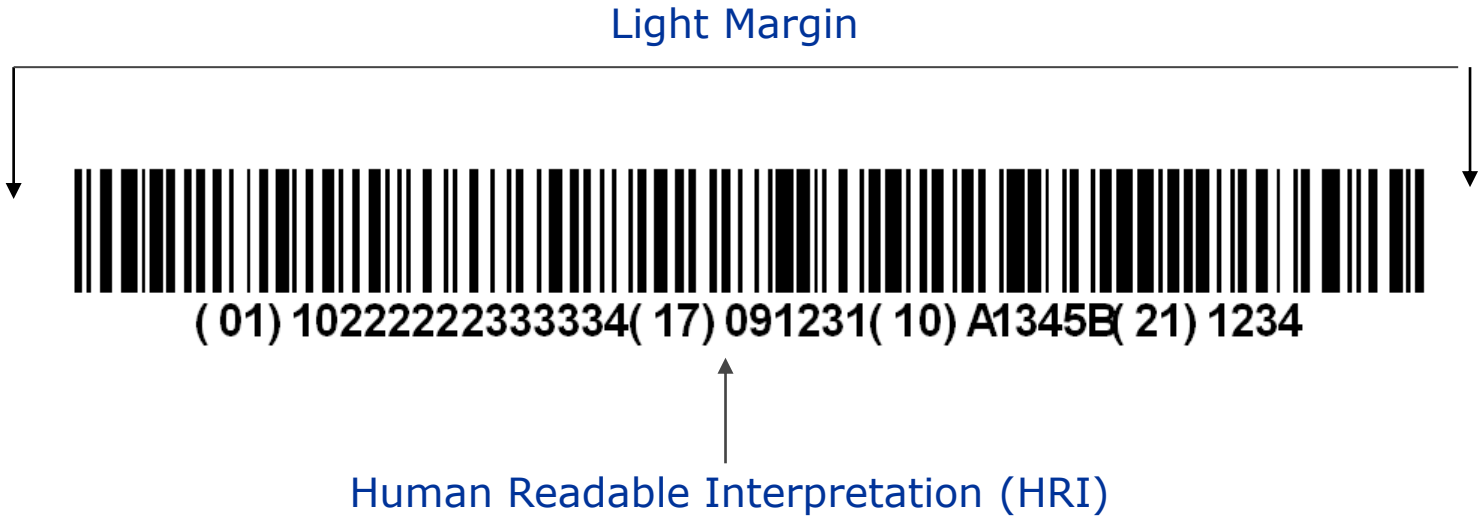
* Only when printed on smooth label / surface

Barcode Symbol Dimensions for ITF-14 Barcode

Mag. factor	X-dimension Narrow element (mm)	Wide element (mm)	Width of Light Margins (10x) (mm)	Min. height of bars (mm)	Excluding bearer bar		Including bearer bar & LM		
					Width not incl LM (mm)	Width incl LM (mm)	Width not incl. H gauges (mm)	Width incl. H gauges (mm)	Height (mm)
0.5	0.508	1.270	5.1	32	61.214	71.41	81.01	87.01	41.6
0.625	0.635	1.588	6.4	32	76.518	89.32	98.92	104.92	41.6
0.7	0.711	1.778	7.1	32	85.700	99.90	109.50	115.50	41.6
0.8	0.813	2.032	8.1	32	97.942	114.14	123.94	129.94	41.6
0.9	0.914	2.286	9.2	32	110.185	128.59	138.14	144.14	41.6
1.0	1.016	2.540	10.2	32	122.428	142.83	152.43	158.43	41.6

Notes : In the heading of this table: Mag. = magnification, LM = Light Margins

GS1-128 Symbol Structure



Barcode Symbol Dimensions for GS1-128 Barcode

Number of characters including AI	Dimensions (mm) including light margin areas				
	MF 0.25	MF 0.4	MF 0.6	MF 0.8	MF 1.0
4	22.0	35.2	52.8	70.4	88.0
6	24.8	39.6	59.4	79.2	99.0
8	27.5	44.0	66.0	88.0	110.0
10	30.3	48.4	72.6	96.8	121.0
12	33.0	52.8	79.2	105.6	132.0
16	38.5	61.6	92.4	123.2	154.0
20	44.0	70.4	105.6	140.8	—
30	57.8	92.4	138.6	—	—

Note 1: One code A or code B character is included in these calculations. If you use more than one code A, B, C, or shift characters, the bar code width will be larger.
Note 2: Calculate widths for other encoded numbers using the formula 11N + 66.

GS1 2D Datamatrix

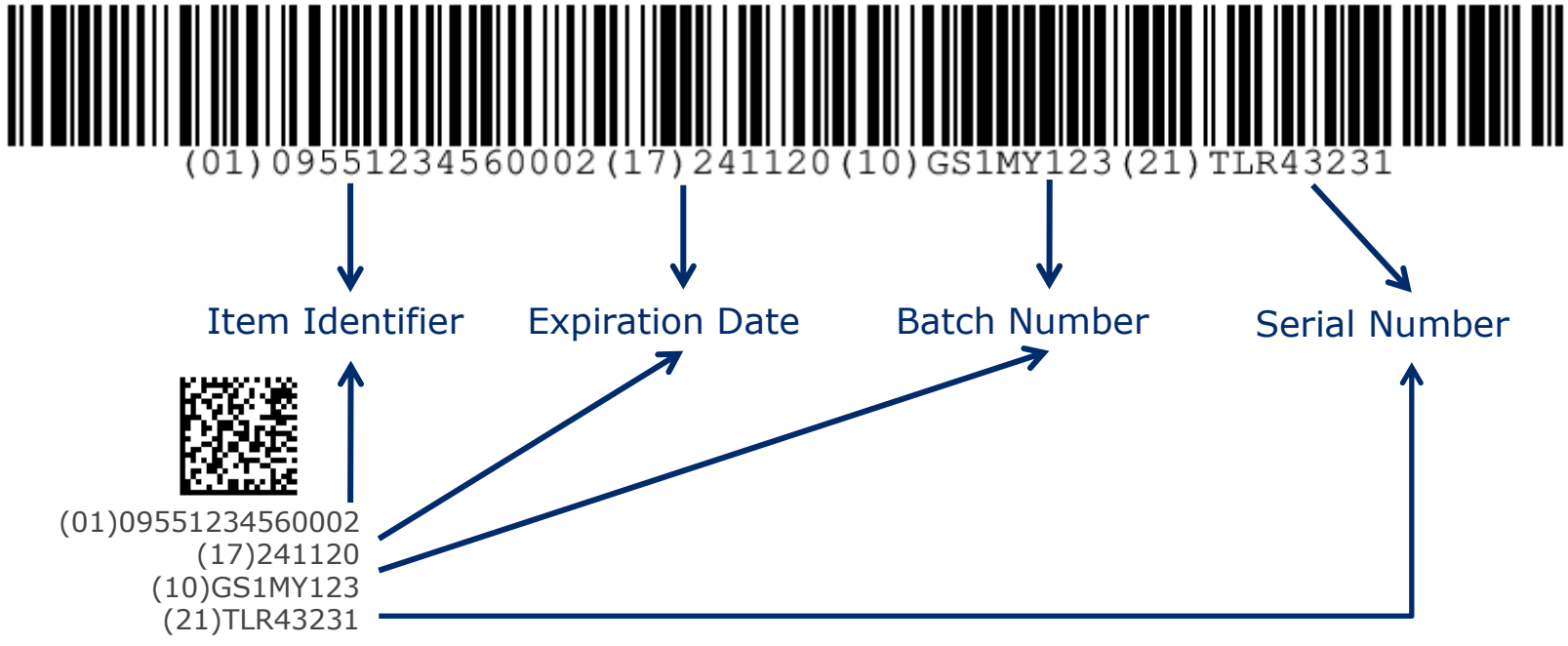
What is a 2D Datamatrix?

- The GS1 2D DataMatrix is a 2D (two-dimensional) barcode symbol.
- The GS1 2D DataMatrix holds large amounts of data in a relatively small space as compared to traditional linear barcodes. Example information – expiry date, batch number & serial number
- Can be used on Retail & Non-Retail Product Units.

(17) 050101 (10) ABC123

(01) 04012345678901

GS1-128 & 2D GS1 Datamatrix Comparison



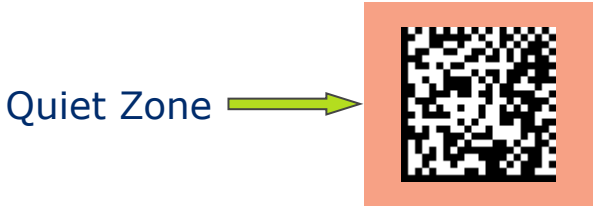
GS1 Datamatrix Measurements

- Measured by number of modules / dots.
- Can be square or rectangle
- Square:
  - Min: 10 x 10 modules, Max: 144 x 144 modules
- Rectangle:
  - Min: 8 x 16 modules, Max: 16 x 48 modules

GS1 Datamatrix Specifications	Recommended module size	Maximum module size	Minimum module size
Printing on a label	0.300mm	0.615mm	0.255mm
Direct Part Mark	0.380mm	0.495mm	0.380mm

Light Margin Area on a 2D Datamatrix

- The Light Margin Area on a 2D Barcode is the area surrounding the 2D Barcode.
- Also called the “Quiet Zone”, it enables the scanner to determine start and end of the bar code
- Like the LMA, this area must be kept clear of dark colours and obstructions.



Examples of 2D Datamatrix Errors

Axis non-conformity

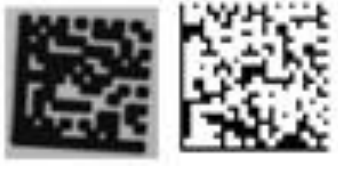
Imbalanced Contrast

Grid non-conformity

Quiet Zone

Modulation

Reflectance



Print Growth

Overall Dimensions of 2D Datamatrix Barcodes

Symbol Specification Table	Symbol(s) specified	X-dimension, in mm (converted into inches)			Minimum symbol height for given X mm (inches)			Quiet Zone		Minimum quality specification	Remarks
		Minimum	Target	Maximum	For minimum X-dimension	For target X-dimension	For maximum X-dimension	Left	Right		
Table 6 Regulated healthcare non-retail consumer trade items not scanned in general distribution	GS1 DataMatrix (ECC 200) **Note 1**	0.254 (0.0100")	0.380 (0.0150")	0.495 (0.0195")	Height is determined by X-dimension and data that is encoded			1X on all four sides		1.5/08/660	
Table 7 Direct part marking	GS1 DataMatrix	0.254 (0.0100″)	0.300 (0.0118″)	0.615 (0.0242″)	Height is determined by X-dimension and data that is encoded			1X on all four sides		1.5/06/660 **Note 3**	For direct marking of items other than medical devices
	GS1 DataMatrix (Ink Based direct part marking)	0.254 (0.0100″)	0.300 (0.0118″)	0.615 (0.0242″)	Height is determined by X-dimension and data that is encoded			1X on all four sides		1.5/08/660 **Note 3**	For direct marking of medical devices such as small medical / surgical instruments
	GS1 DataMatrix (direct part marking-A **Note 2**)	0.100 (0.0039″)	0.300 (0.0118″)	0.300 (0.0118″)	Height is determined by X-dimension and data that is encoded			1X on all four sides		DPM1.5/04-12/650/(45Q|30Q|30T|30S|90) **Note 4**	For direct marking of medical devices such as small medical / surgical instruments
	GS1 DataMatrix (direct part marking-B **Note 2**)	0.200 (0.0079")	0.200 (0.0079″)	0.495 (0.0195″)	Height is determined by X-dimension and data that is encoded			1X on all four sides		DPM1.5/08-20/650/(45Q|30Q|30T|30S|90) **Note 4**	For direct marking of small medical / surgical instruments

Overall Dimensions of a 2D Datamatrix Barcode Symbol

Symbol Specification Table	Symbol(s) specified	X-dimension, in mm (converted into inches)			Minimum symbol height for given X mm (inches)			Quiet Zone		Minimum quality specification	Remarks
		Minimum	Target	Maximum	For minimum X-dimension	For target X-dimension	For maximum X-dimension	Left	Right		
Table 8 Trade items scanned in retail pharmacy and general distribution or non-retail pharmacy and general distribution	GS1 DataMatrix (ECC 200) **Note 1**	0.750 (0.0300")	0.750 (0.0300")	1.520 (0.0600")	Height is determined by X-dimension and data that is encoded			1X on all four sides		1.5/20/660	
Table 9 GS1 keys GDTI, GRAI, GIAI and GLN	GS1 DataMatrix (ECC 200) **Note 1**	0.380 (0.0150")	0.380 (0.0150")	0.495 (0.0195")	Height is determined by X-dimension and data that is encoded			1X on all four sides		1.5/08/660	
Table 10 Regulated healthcare retail consumer trade items not scanned in general distribution	GS1 DataMatrix (ECC 200) **Note 1**	0.396 (0.0156")	0.495 (0.0195")	0.990 (0.0390")	Height is determined by X-dimension and data that is encoded			1X on all four sides		1.5/08/660	
Table 11 GS1 GSRNs	GS1 DataMatrix (ECC 200) **Note 1**	0.254 (0.0100")	0.380 (0.0150")	0.495 (0.0195")	Height is determined by X-dimension and data that is encoded			1X on all four sides		1.5/08/660	
Table 8 Trade items scanned in retail pharmacy and general distribution or non-retail pharmacy and general distribution	GS1 DataMatrix (ECC 200) **Note 1**	0.750 (0.0300")	0.750 (0.0300")	1.520 (0.0600")	Height is determined by X-dimension and data that is encoded			1X on all four sides		1.5/20/660	

Overall Dimensions of a 2D Datamatrix Barcode Symbol

Notes:

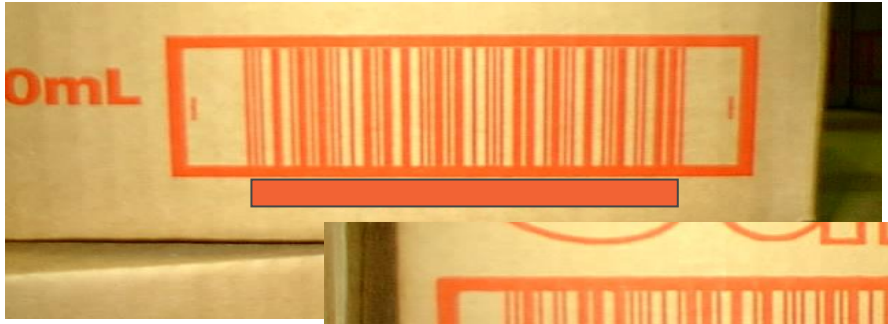
Note 1: 2D X-dimension - Optical effects in the image capture process require that the GS1 DataMatrix symbol be printed at 1.5 times the equivalent printing X-dimension allowed for linear or Composite symbols.

Note 2: There are two basic types of non ink based direct part marks, those with "connected modules" in the "L" shaped finder pattern: (GS1 DataMatrix direct part marking – A) created by DPM marking technologies such as laser or chemical etching and those with "non connected modules" in the "L" shaped finder pattern (GS1 DataMatrix direct part marking – B) created by DPM marking technologies such as dot peen. Due to the marking technologies and characteristics of reading they each have varied ranges of X-dimensions and different quality criteria recommended and may require different reading equipment. GS1 DataMatrix – A is suggested for marking of medical devices such as small medical / surgical instruments. The Minimum X-dimension of 0.100mm is based upon the specific need for permanence in direct marking of small medical instruments which have limited marking area available on the instrument with a target useable area of 2.5mm x 2.5mm and a data content of GTIN (AI 01) plus serial number (AI 21).

Note 3: The effective aperture for GS1 DataMatrix and GS1 QR Code quality measurements SHOULD be taken at 80 percent of the minimum X-dimension allowed for the application. For direct part marking - A this would equate to an aperture of 3; for direct part marking – B this would equate to an aperture of 6 and for general healthcare label printing, an aperture of 8. See ISO/IEC 15415 and ISO/IEC TR 29158.

Note 4: Any "Type A" mark that meets the grade requirements under the quality techniques specified in ISO/IEC 15415 is considered acceptable. If the letters "DPM" precede the grade it indicates that the grade was obtained by following ISO/IEC TR 29158 (AIM DPM) and not ISO/IEC 15415 whether "Type A" or "Type B".

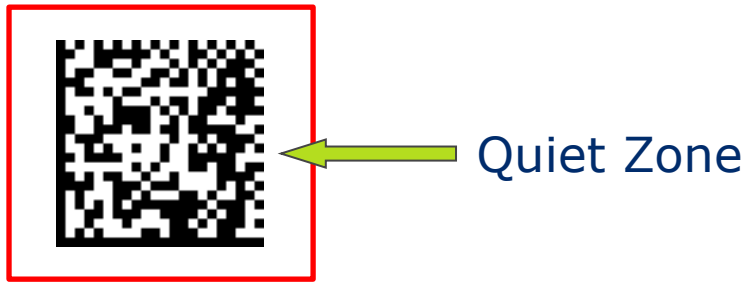
The Colour Red & Barcodes



Humans can see red..

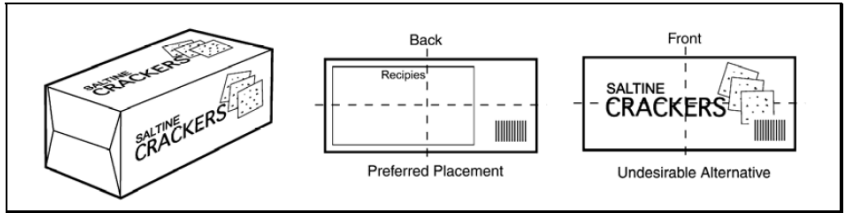
Scanners can’t!!!

Light Margin Area (LMA) & Quiet Zone

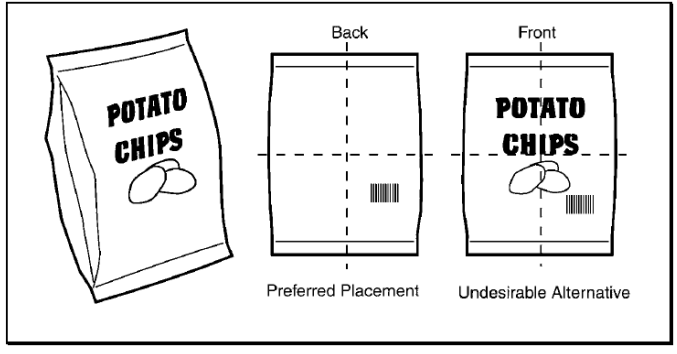


- Determines whether a barcode symbol can be properly scanned.
- All barcodes must have a clear and blank space in front, behind or around it to ensure no design or colour choices will affect the scanning.

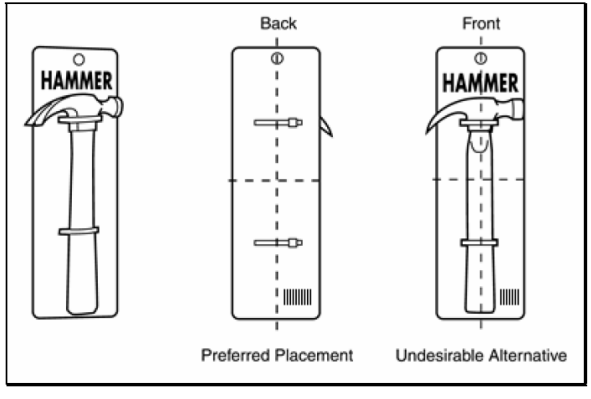
Product-level Symbol Locations & Orientation



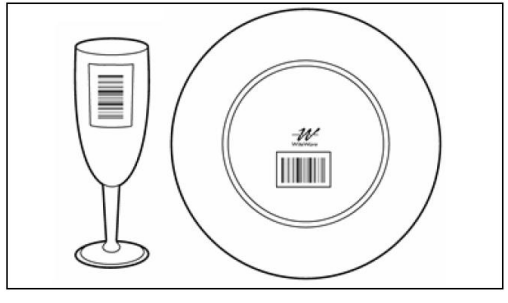
Single Pack



Bag-type

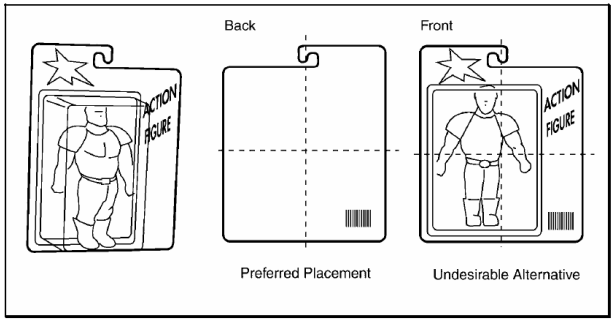


Card Holder



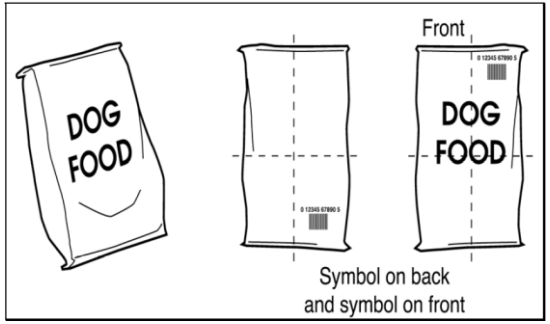
Sticky Label

Product-level Symbol Locations & Orientation

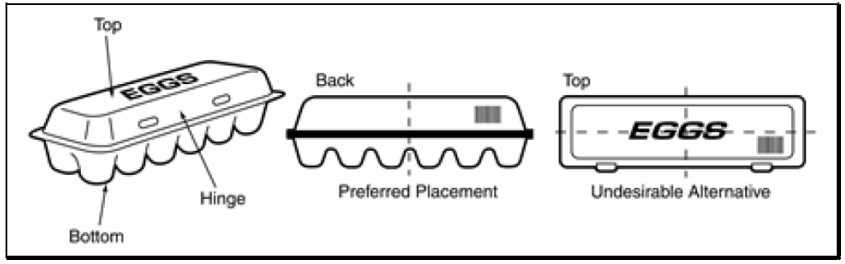


Blister Pack

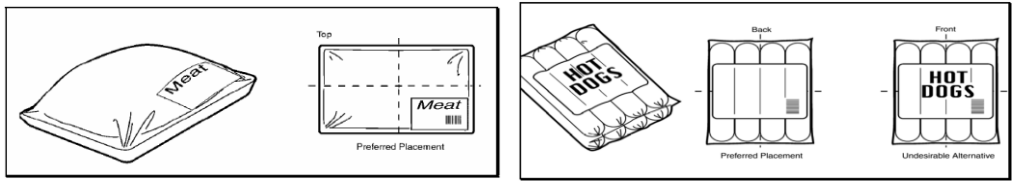
Hanging Label



Large, Bulky Items

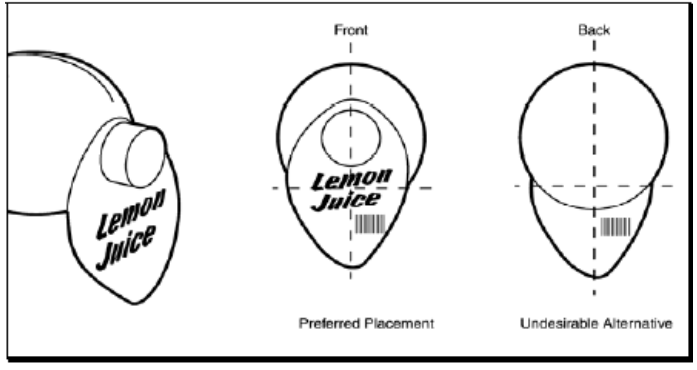


Egg Carton

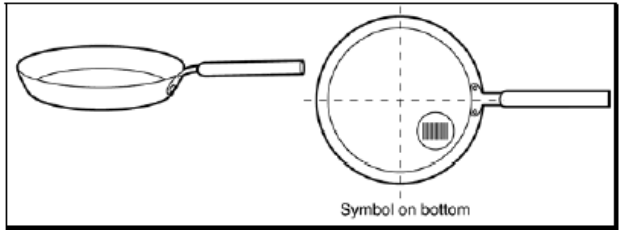


Cold/Frozen Label

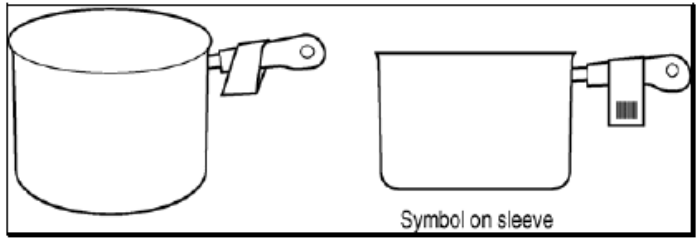
Product-level Symbol Locations & Orientation



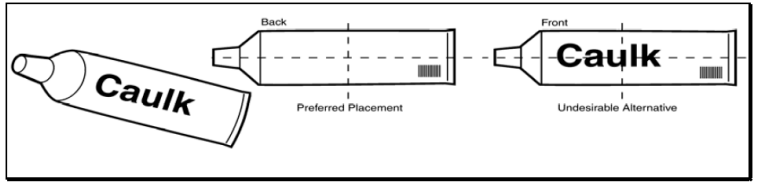
Tab Label



Spot Label

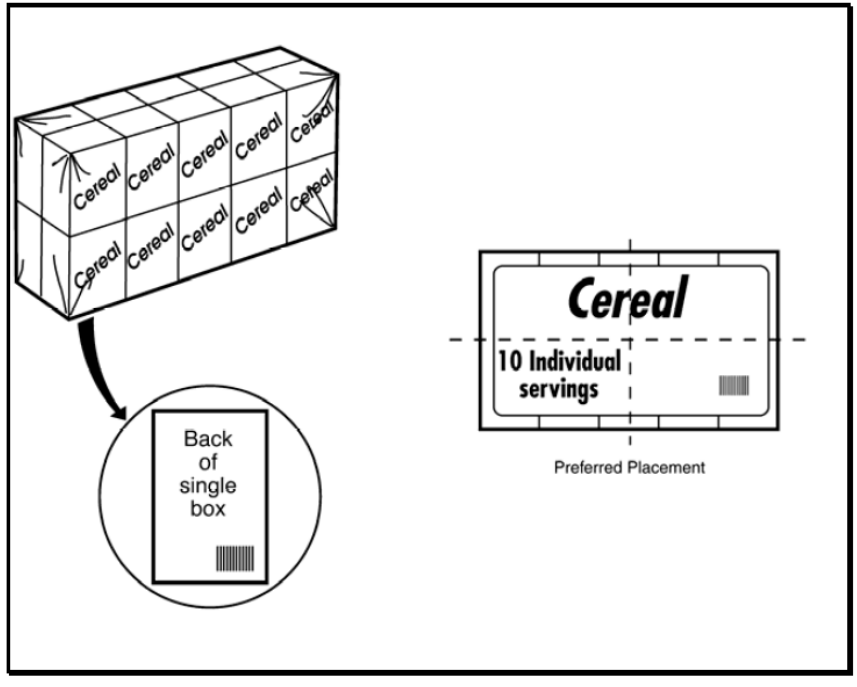


Sleeve Label



On Tube-type

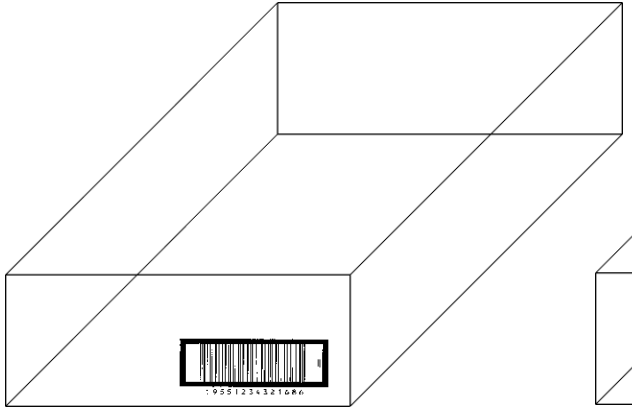
Product-level Symbol Locations & Orientation



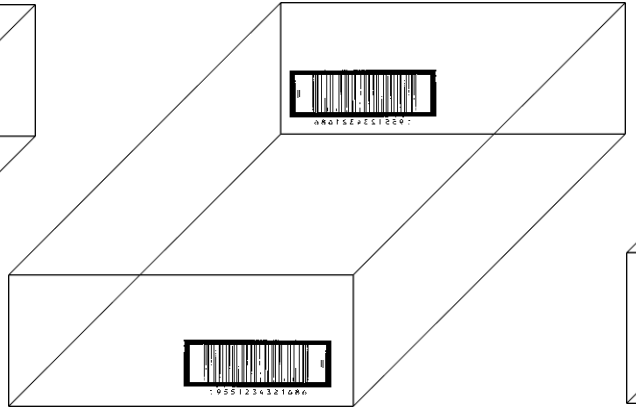
When a product can be sold individually or in a multi-pack

Locations of Barcode on Outer Case Carton/Transportation Unit

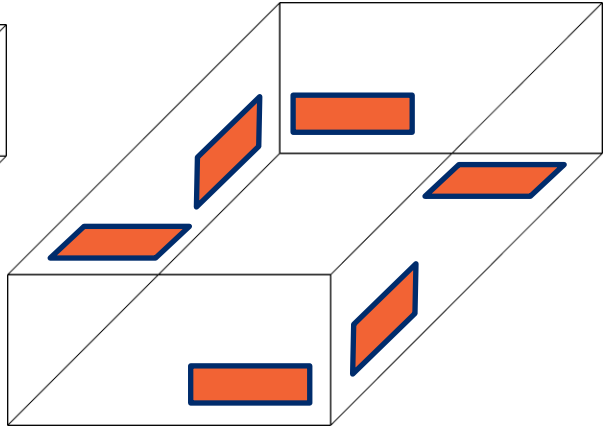
- Two barcode labels on adjacent sides (a short side and the long side on the right) is recommended.
- At least one label on any side (except on the base)



1 label on 1 side - **Minimum**



1 label on 2 sides - **Standard**



1 Label on 6 sides - **Optimal**

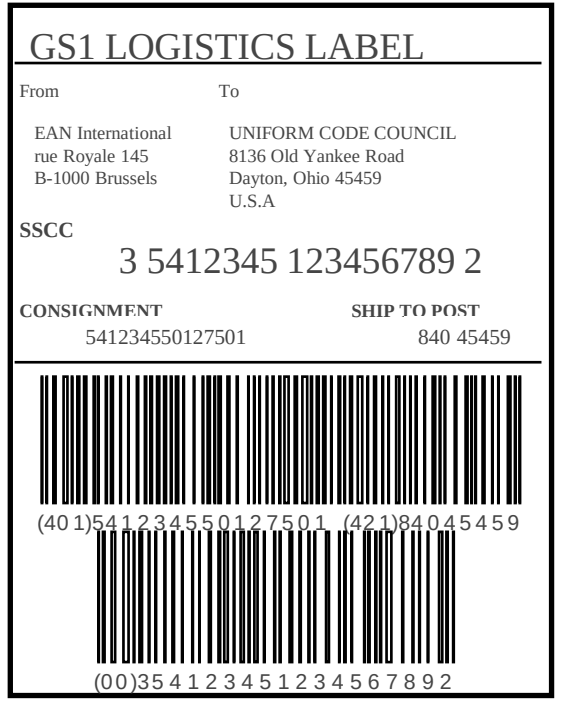
Structure of the GS1 Logistics Label

GS1 logistics labels can be divided into three sections:

The **top section** of the label contains free format information

The **middle section** contains text information and human readable interpretations of the bar codes

The **lowest section** includes the bar codes and their associated interpretation. SSCC must be the lowest



Barcode Symbol Considerations, Summary

Size, Placement, Direction & Material

- Kindly take note that the **size**, **placement,** and **direction** of the barcode symbol on your packaging is very important to ensure they can be read by barcode scanners. The **material** the barcode is printed on also plays a role; for example, if it is too reflective, the symbol cannot be scanned.

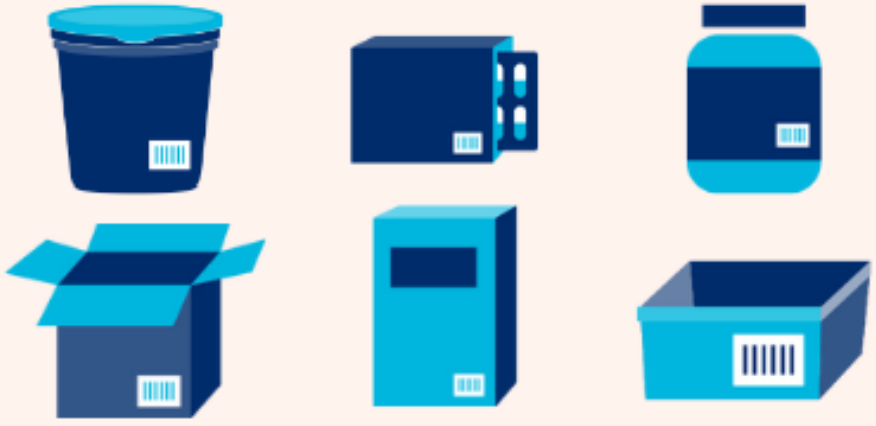
Barcode Symbol Image Maintenance

- You should take care not to **change the size** of a generated barcode symbol when you are adding it to your artwork. Any adjustment to the symbol after it has been generated will affect whether it can be read. Please **generate a smaller or larger symbol if it does not fit** in your artwork, do not shrink, or expand it.

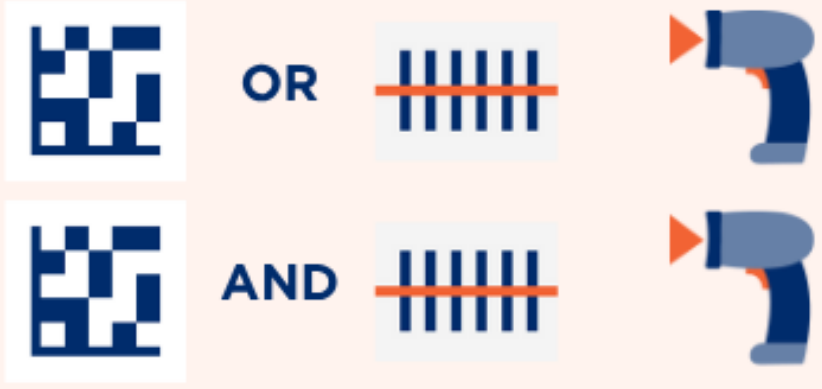
Importance of the Light Margin or Quiet Zone

- Please also ensure that there is sufficient **Light Margin**, which is the **empty space before and after a barcode symbol**, especially when there is a direct color contrast between your barcode symbol and the product artwork. This is to ensure that the barcode scanner will only scan the barcode symbol and nothing else.

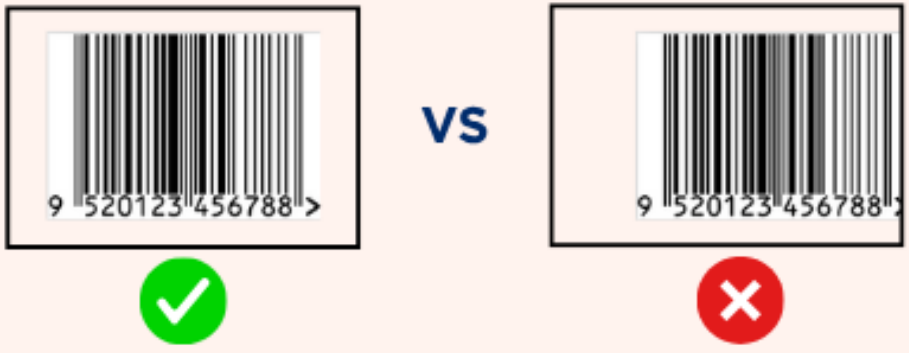
Barcode Print Quality



In general, a barcode symbol should be placed at the **bottom right corner** of your packaging.



Only **Camera-based barcode scanners** can read 2D barcodes, but they can also read 1D barcodes.



Ensure that your printed or labelled barcode is in the **center of the area** you have set aside for it, or there will be **reading errors**.

The **quality** & **condition** of a barcode label is crucial for a successful read by barcode scanners.

Barcode Print Quality

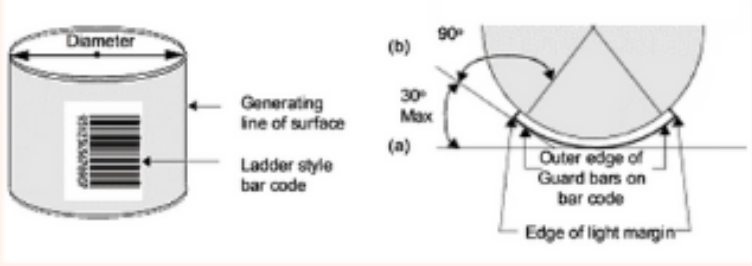
Min
X-dimension
0.264 mm
(0.0104")

Target
X-dimension
0.330 mm
(0.0130")

Max
X-dimension
0.660 mm
(0.0260")

X-dimension = The specified width of the narrowest element of a barcode

NEVER Adjust the size of a barcode symbol after generation!



On **rounded surfaces**, it is advisable to print the barcode in **ladder orientation**, rather than the traditional **picket fence orientation**, to maximize barcode symbol readability.

Picket Fence Orientation

Ladder Orientation

- Bars must appear **black** under **red light**.
- Bars may be black, blue, green – **cold colours**.
- Background may be white, red, yellow, orange - **warm colours.**
- Colours used must be **pure colours**
- **Reversed colour images** (white bars against a coloured background) **cannot be scanned.**

- Avoid **truncating** a barcode symbol, the process of **reducing** the **height** of a symbol but half or more.
- Truncation **limits** the **readability** of the symbol by certain barcode scanners.

Barcode Certification Program

Providing Barcode Quality Control for GS1 Standards-based Barcode Symbols

(1) Validation

Confirms the **right barcode** is on the **right product** from the **right company**, with the **right details**.

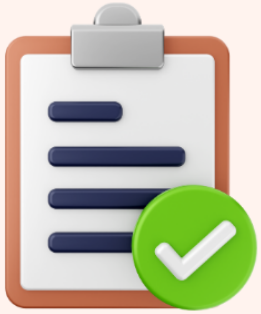
(2) Verification

Guarantees your barcode will **scan successfully** on the **first & every try**, by **any POS**, **any store** or **any warehouse**.

(3) Decoding

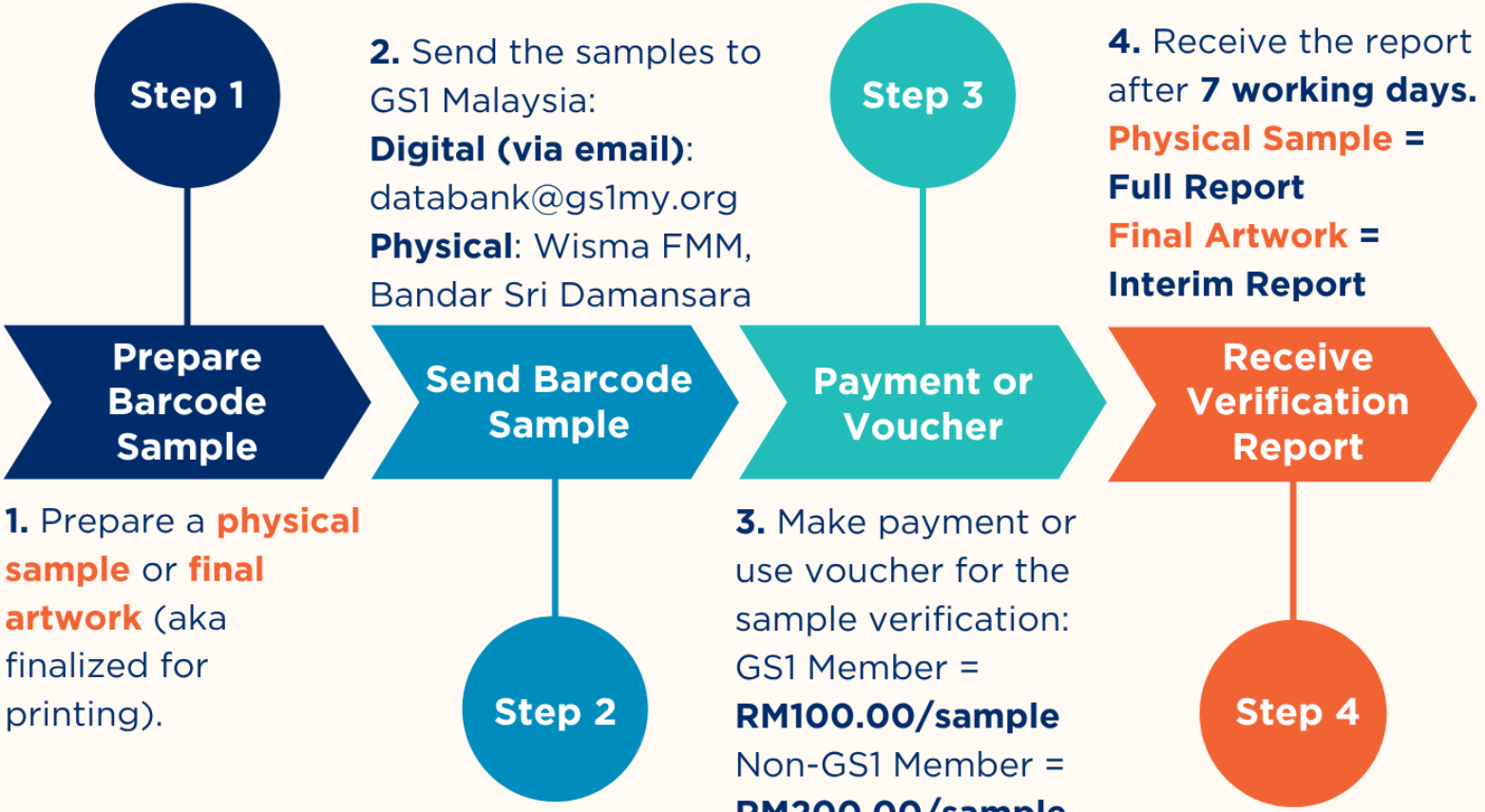
Reviews your barcode's **structure** to see if the data is **accurate** & **correctly formatted** to **GS1 Standards**.

GS1 Barcode Certification Report



- **Globally Recognized**
- Ensures **readability first & every time, anywhere,** with **accurate data**
- RM100/label **- Member**
- RM200/label **- Non-member**

Verify Your Barcode Labels with GS1 Malaysia



Official GS1 Communications Channels

Official GS1 Malaysia WhatsApp

+6014-3933 228
(Membership, Services & Support)

+6011-1616 8228
(Membership, Services & Support)

+6016-2455 228
(Strictly for Payment Only)

+6012-2722 646
(Strictly for Payment Only)

Official GS1 Malaysia Emails

gs1malaysia@gs1my.org

membership@gs1my.org

payment@gs1my.org

databank@gs1my.org

Official GS1 Malaysia Land Line

Land: +603-6286 7200

Official GS1 Malaysia Website

www.gs1my.org