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.

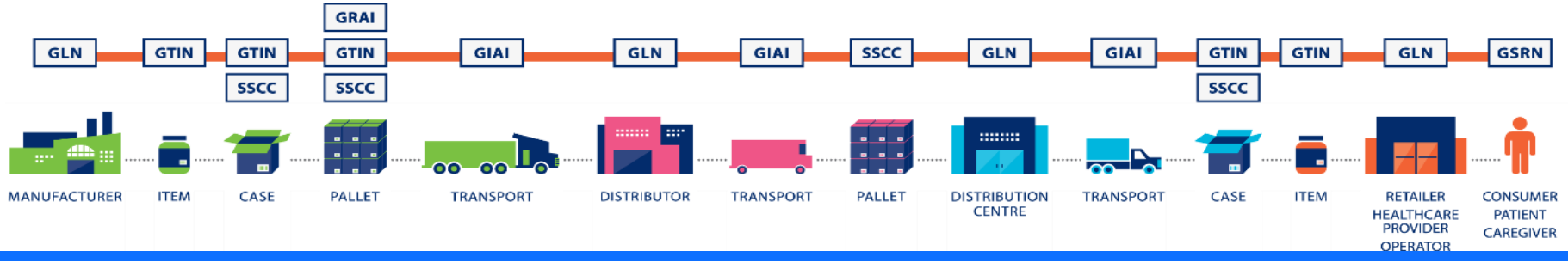
Each dark bar/dot and light space arrangement represents a number or character !

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)

Barcode Symbols Recognised by GS1

Product-level Packaging (Retail)

EAN-13

UPC-A

EAN-8

UPC-E

GS1 DataBar

Carton-level Packaging (Non-retail)

ITF-14

GS1-128

Multi-level Packaging (Retail and Non-retail)

GS1 2D DataMatrix

GS1 QR Code

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%.

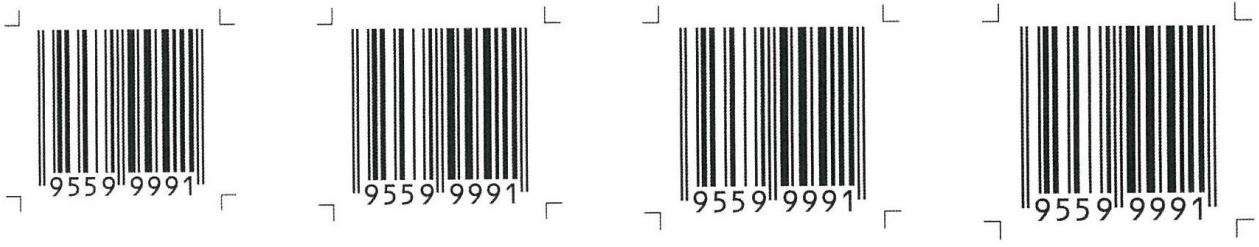
85% 90% 95% 100%

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%

Overall Dimensions of 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

Overall Dimensions of EAN-13 and EAN-8 Barcodes

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

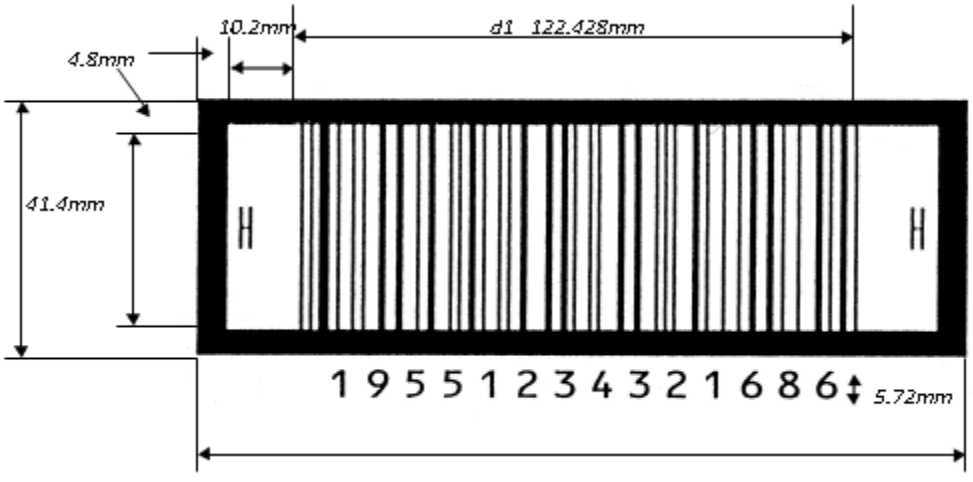
Note:

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 Barcode



- The ITF-14 bar code can be printed with a magnification factor ranging from **25%** to **100%**.
- To ensure efficient reading in any environment, including conveyor belt scanning, a minimum magnification factor of **50%** should be used.
- ITF-14 bar codes with a magnification less than **62.5%** should not be printed directly on corrugated material.

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 Barcode

- For general distribution, the height for a GS1-128 is **32mm**.
- Where space constraints do not allow the barcode to be printed at the minimum recommended height, it should not be lower than **13mm** in height.

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

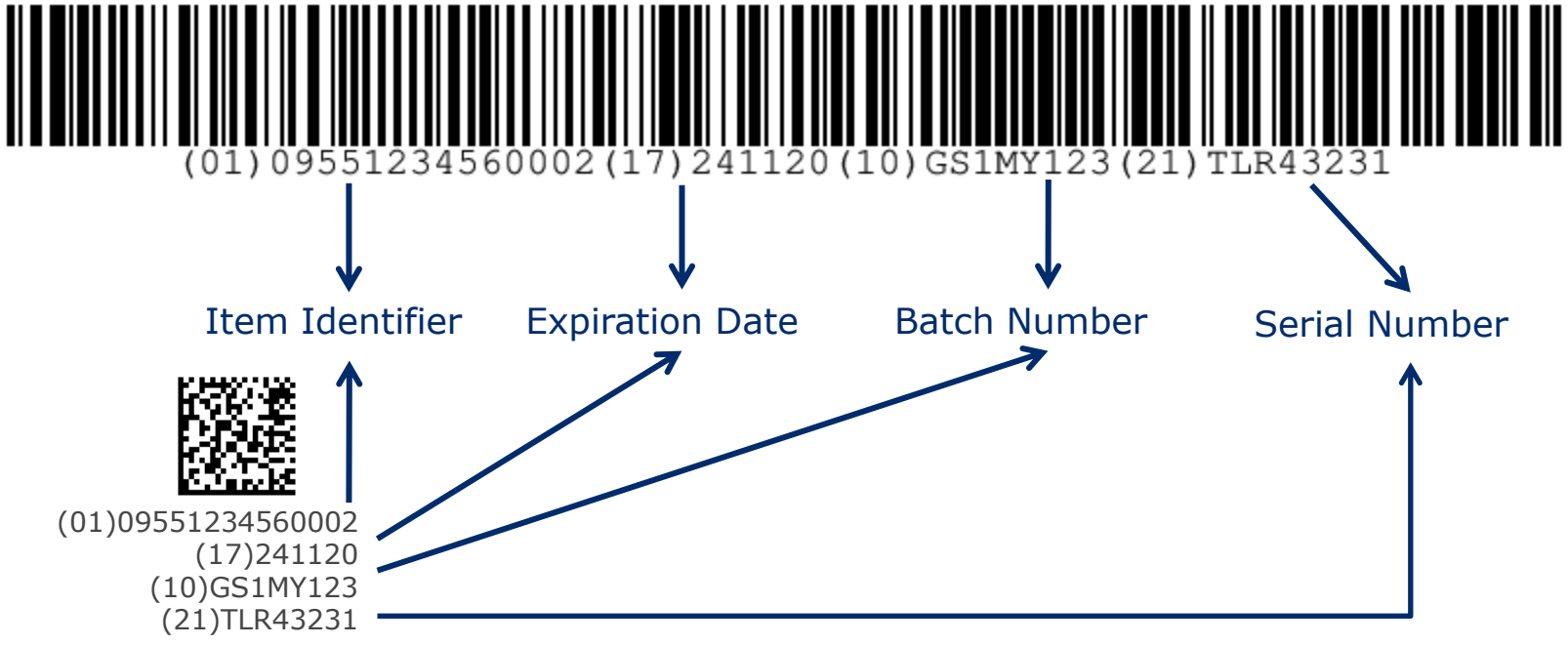
What is a 2D Datamatrix?

- 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



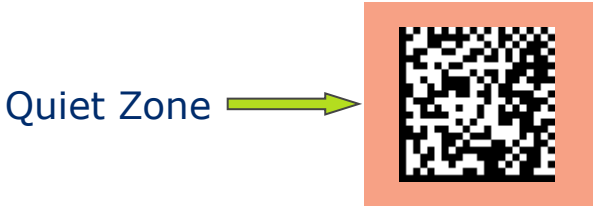
GS1 Datamatrix Measurements

- 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.

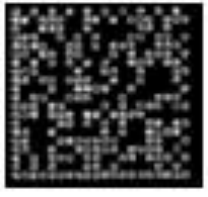


Examples of 2D Datamatrix Errors

Axis non-conformity

Modulation

Imbalanced Contrast



Reflectance

Grid non-conformity

Print Growth

Quiet Zone

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.

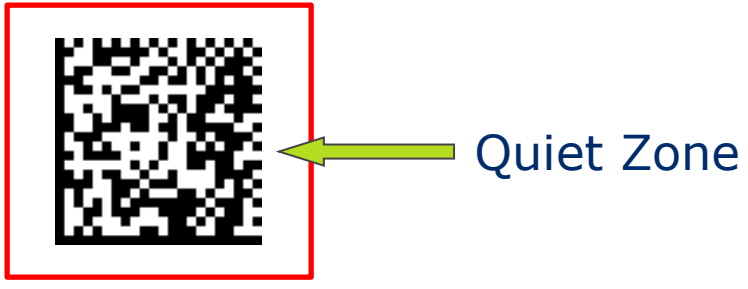
Note 4: Any "Type A" mark that meets the grade requirements under the quality techniques specified in ISO/IEC 15415 is considered acceptable. If the letters "DPM" precede the grade it indicates that the grade was obtained by following ISO/IEC TR 29158 (AIM DPM) and not ISO/IEC 15415 whether "Type A"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

The Colour Red & Barcodes

Humans can see red..

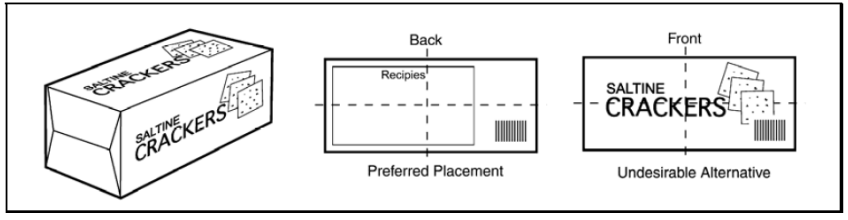
Scanners can’t!!!

Light Margin Area (LMA) & Quiet Zone

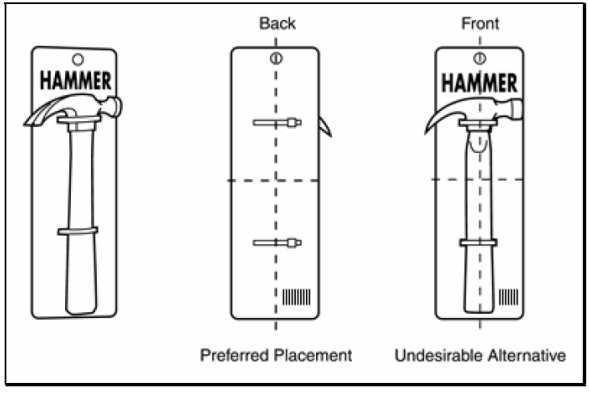


- Determines whether a barcode symbol can be properly scanned.
- All barcodes must have a clear and blank space in front, behind or around it to ensure no design or colour choices will affect the scanning.

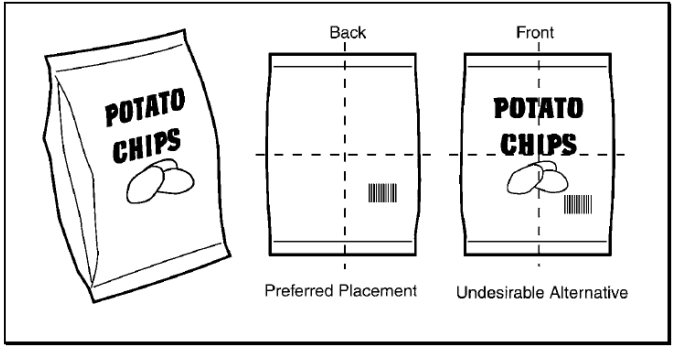
Product-level Symbol Locations & Orientation



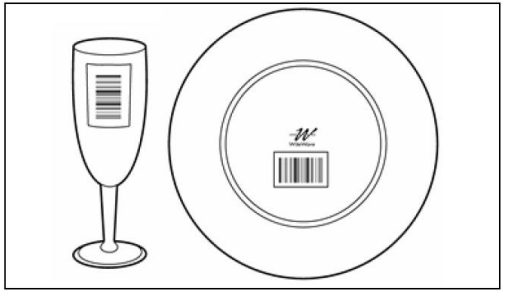
Single Pack



Card Holder

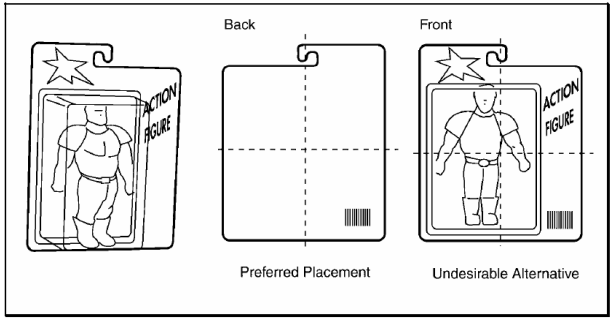


Bag-type



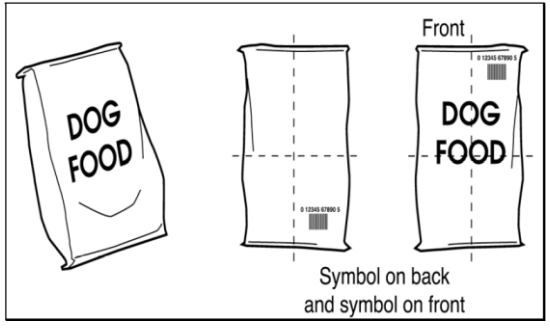
Sticky Label

Product-level Symbol Locations & Orientation

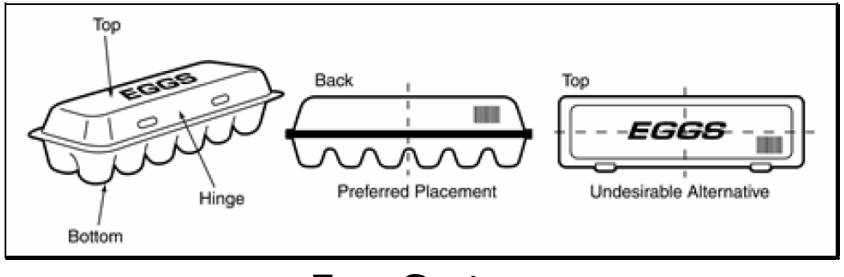


Blister Pack

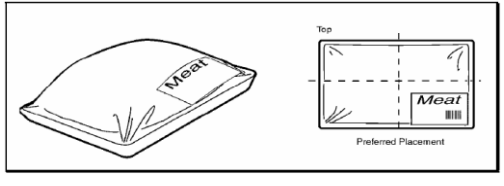
Hanging Label

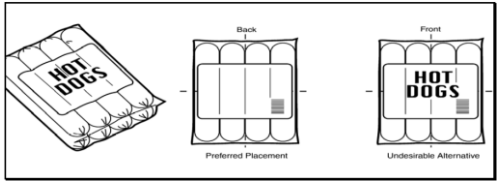


Large, Bulky Items



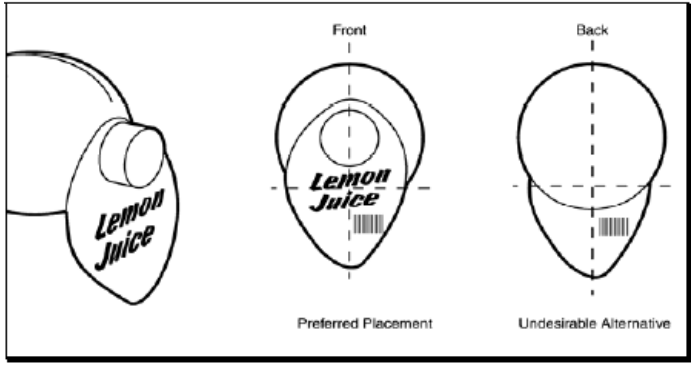
Egg Carton



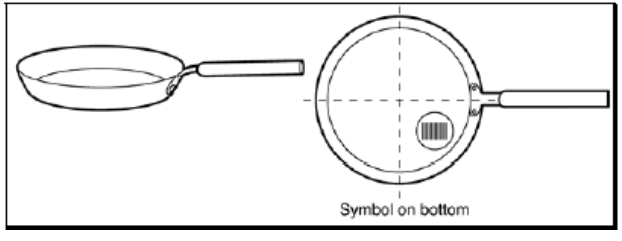


Cold/Frozen Label

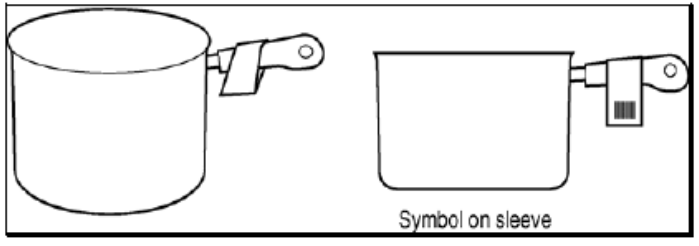
Product-level Symbol Locations & Orientation



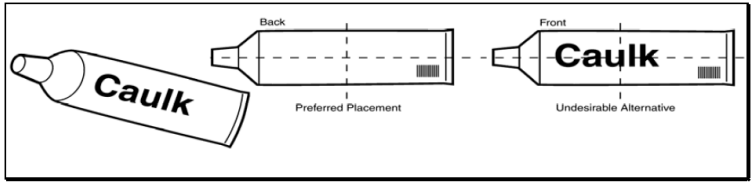
Tab Label



Spot Label

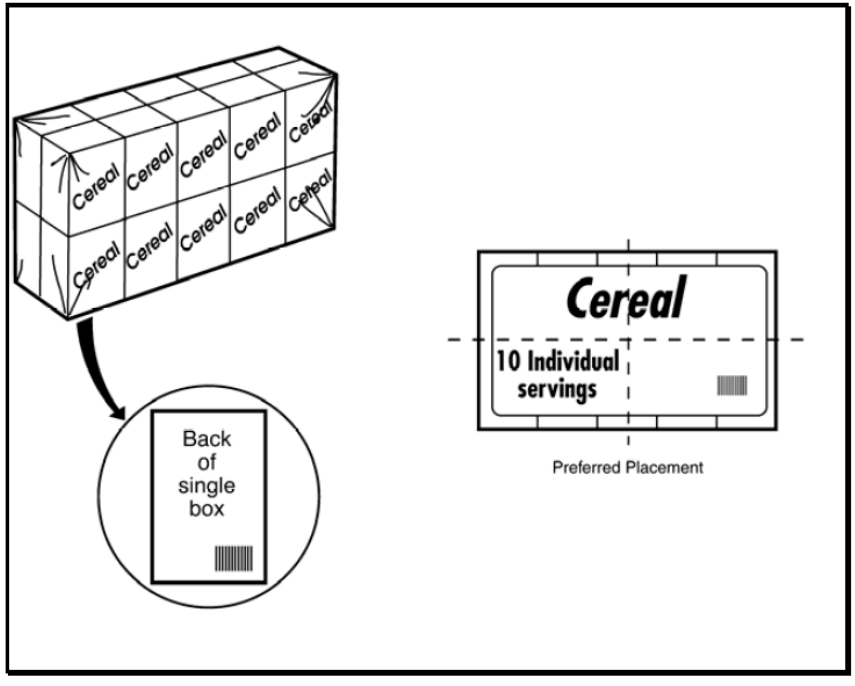


Sleeve Label



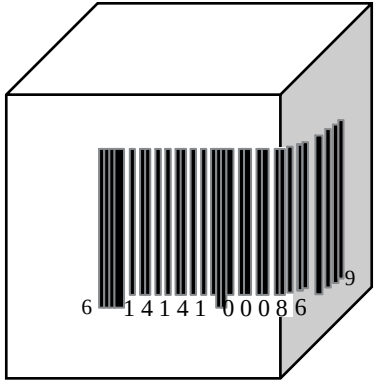
On Tube-type

Product-level Symbol Locations & Orientation

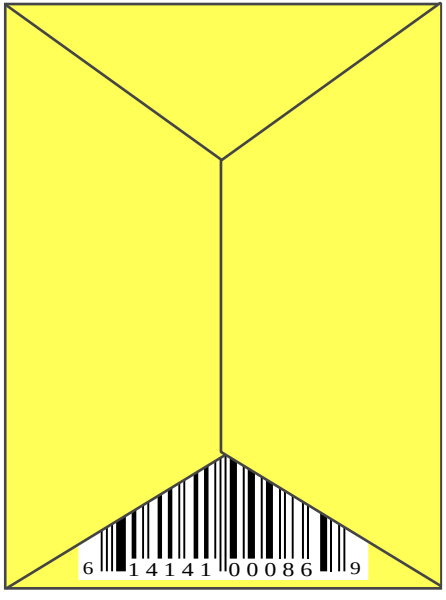


When a product can be sold individually or in a multi-pack

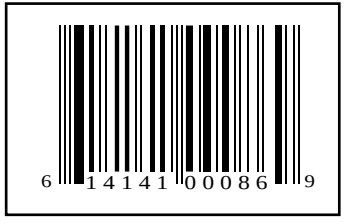
Symbol Locations & Orientation



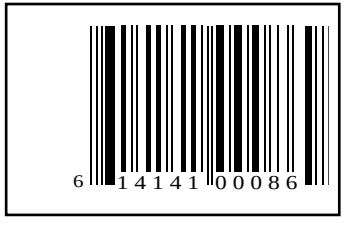
Avoid Corner Wraps



Avoid Package Flaps



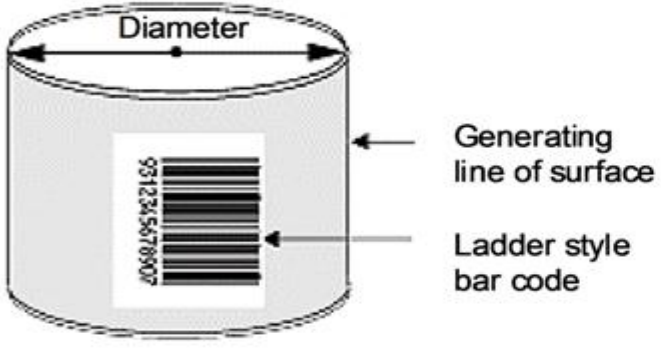
Centered On Label

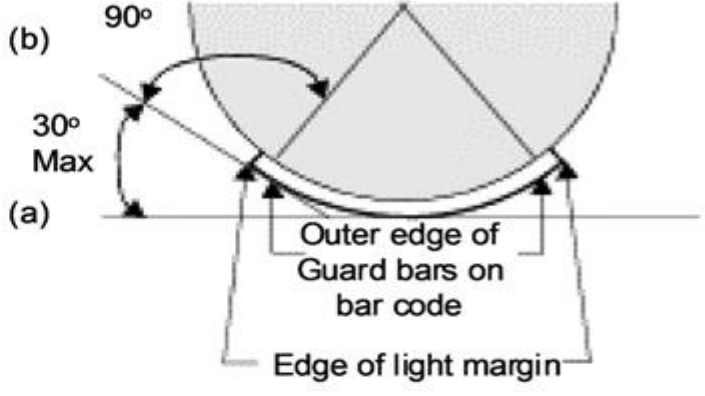


Not Centered - Information Lost

Symbol Locations & Orientation

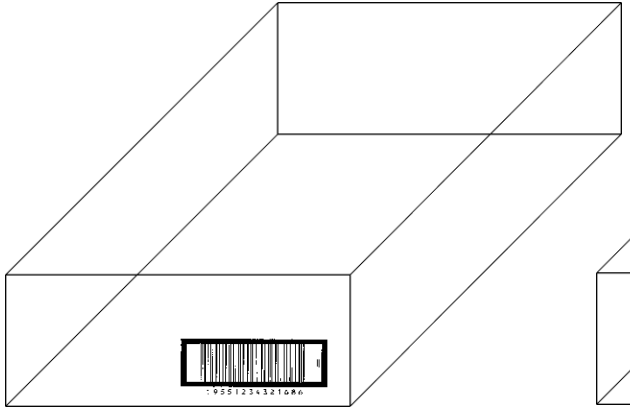
- When placing barcodes on rounded or curved surfaces, always place them in the "**ladder**" style instead of the standard "**fence**" style.
- Typical barcode scanners utilise an infrared laser that can only scan flat and smooth images.



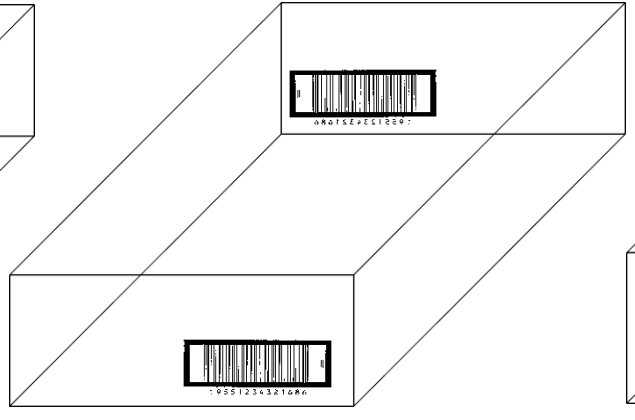


Locations of Barcode on Outer Case Carton/Transportation Unit

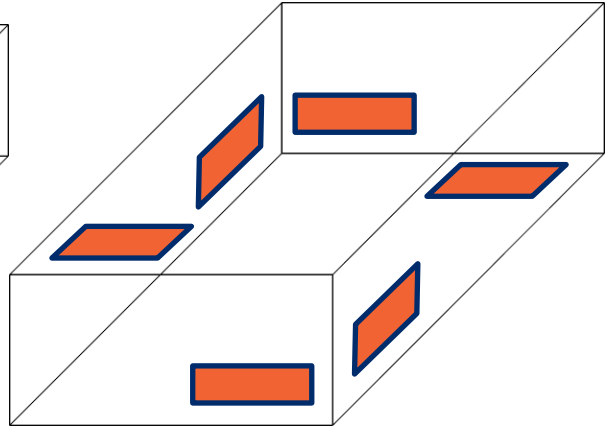
- Two barcode labels on adjacent sides (a short side and the long side on the right) is recommended.
- At least one label on any side (except on the base)



1 label on 1 side - Minimum



1 label on 2 sides - Standard



1 Label on 6 sides - Optimal

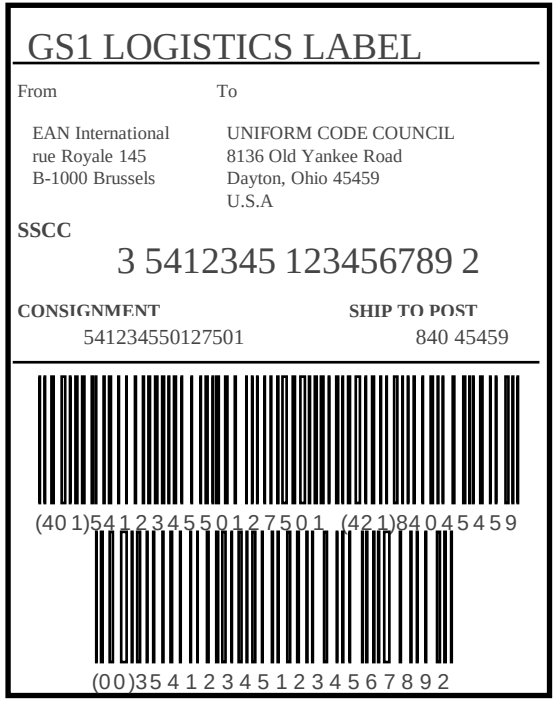
Structure of the GS1 Logistics Label

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

- 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.
- 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.
- 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 Symbol Specifications - Recap

- When barcodes fail to scan the first time, every time; delays and errors are introduced into the supply chain. Avoid time and monetary losses when having to re-design, re-print or recall products due to ineffective or unworkable barcodes
- Key considerations:
  - **Size**

Min X-dimension * 0.264 mm (0.0104”)

Target X-dimension 0.330 mm (0.0130”)

Max X-dimension 0.660 mm (0.0260”)

Scan here!

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

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

Want to learn more?

Attend GS1 Malaysia's
Capacity Building & Implementation Program
to find out more!

GS1 MALAYSIA CAPACITY BUILDING FREE BRIEFINGS

(1) Fulfilling Market & Regulatory Guidelines Using GS1 Standards	(2) GS1 2D Standards and VbG-PDSS Fulfil Sustainability & Circularity	(3) GS1 Malaysia 2D Repository Platform	(4) The Impact of GS1 Global Location Numbers (GLN) on Business, Social, Regulation & Customer
• Understand why GS1 Standards & Keys is widely recognised and accepted • Learn why GS1 Standards & Keys protects product identity integrity and improves the Customer Buying Experience.	• Learn how GS1 supports the growing Green movement's calls for sustainability & circularity through GS1's for greater product visibility, traceability, and authentication.	• Experience how 2D track & trace works with the GS1 Malaysia 2D Repository Platform! • An intermediary repository before the future National Pharmaceutical Track & Trace system.	• Supporting compliance to EU directives such as EUDR, ESPR, CEAP, etc. on Sustainability and Circularity using GS1 unique identification (GLN) • Fulfil Digital Product Passport (DPP) requirements
3.00pm to 4.00pm (Every Monday and Wednesday)	11.00am to 11.45am (Every Thursday)	3.00pm to 4.00pm (Every Tuesday)	11.00am to 11.45am (Every Friday)
Zoom Link: https://us06web.zoom.us/j/89614519211	Zoom Link: https://us06web.zoom.us/j/89770665451	Zoom Link: https://us06web.zoom.us/j/82513900764	Zoom Link: https://us06web.zoom.us/j/86884634932

** GS1 Malaysia reserves the right to adjust the sessions based on availability & minimum attendance.*

GS1 MALAYSIA PREMIUM CAPACITY BUILDING TRAINING SCHEDULE

Premium Capacity Building Training Sessions

Industry Focus Forums (Chargeable)

Topic 1	Topic 2
Supply Chain Optimisation and Regulatory Fulfilment using Global Location Number (GLN) and GS1 Services	Meeting Global Healthcare and UDI Guidelines using GS1 Standards
• *Comply with **Retail Merchandising Principles*** • *Fulfil **Global Regulatory Compliance*** • *Track & Trace using GS1 Traceability guidelines and 2D Datamatrix.*	• *Achieve compliance with international and country-specific directives on Healthcare Products, such as **US FDA GUDID, EU EUDAMED, China NMPA, UAE BrandSync, etc.***

1-3 pax:	4-6 pax:	7-10 pax:
RM 500.00	***RM 800.00***	***RM 1,500.00***

In-House Training & Business Consultation (Chargeable)

- *Training is **tailored** to company's requirements*
- *Can be conducted at **company's premises of choice** or via **Zoom***
- *Full day session includes **quiz activity***
- ***Travelling charges** will be incorporated into the training fees*

In-house Session Fee Breakdown:

http://gs1my.org/?q=node/220&tab=2

Contact GS1 Malaysia at **gs1malaysia@gs1my.org** to arrange for a session.

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