GS1

New Zealand

User Guide

March 2021

User Guide

GS1 New Zealand is part of the global GS1 network. We are a not for profit association with over 8,000 New Zealand members, who join over two million member companies worldwide. GS1 New Zealand aims to make supply chain standards and the related technology accessible and affordable for the largest to the smallest companies.

Our standards and services for barcoding, electronic business messaging, data synchronisation and radio frequency technology are founded on the global GS1 System. GS1 standards allow businesses to seize opportunities in areas such as traceability, inventory management, point of sale/use and collaborative planning.

Using this guide to get barcodes on your products

• Go to the 'Barcode Quick Start Guide' on the next page
• Work through each step referring to the indicated section of this guide at each point
• Read the guide completely to become familiar with the many aspects of the GS1 system.

Barcode Quick Start Guide

Following this Barcode Quick Start Guide will get you started quickly and easily. GS1 New Zealand recommends that you reference this booklet to ensure you understand and meet GS1 specifications or industry requirements.

Step 1

Get a barcode for your product

Obtain a barcode number (GTIN) for your product by using MyGS1. e.g. GTIN-13, GTIN-14, GTIN-8. See Appendix 1, page 28.

If you need to identify pallets, use a Serial Shipping Container Code (SSCC). See Appendix 1, page 31.

Step 2

Download the barcode symbol

Download the barcode for your product using MyGS1 to send to your printing provider.

If you are unsure which barcode to use, see Appendix 1, page 28.

Step 3

Print your barcodes

Print barcodes on your product packaging with your printing provider.

See pages 32 to 33 for information on correct barcode sizes.

Step 4

Get your products ready to launch

Talk with GS1 about barcode checks and your product photography as well as to make sure your label data is captured with GS1.

Other GS1 services you may find useful:

☑ **ProductFlow**   ☑ **MediaLibrary**   ☑ **Consultancy**

Need assistance

Contact GS1 Support Team:

Phone   **0800 10 23 56**
Email   **support@gs1nz.org**
Website   **www.gs1nz.org**

Contents

1 The origin of the GS1 system

The barcode was one of several methods developed for the automatic reading of numbers in the years following World War II. The American grocery industry realised that the new technology had the potential to revolutionise supply chain management and in 1972 the Uniform Code Council (UCC) was formed by a coalition of interested companies and industry organisations. The new organisation's mission was to design and implement a suitable identification and barcode system usable in any industry, throughout the whole supply chain. In April 1974 retail scanning began in the USA.

Several European countries cooperated to form the European Article Number (EAN) Association to roll out the American system for worldwide use. EAN International was established in 1977 and other countries quickly became involved. The first scanning store opened in New Zealand in 1982, just three years after the New Zealand Product Number Association (now GS1 New Zealand) was founded.

By 1993, New Zealand led the world in the degree of scanning penetration in supermarkets. In that year 85 cents in every dollar's worth of groceries was sold through scanning checkouts. Since then the GS1 system has become established well beyond grocery in all retail sectors and throughout most of their supply chains.

In January 2005 EAN International and the UCC merged into one organisation, now known as GS1.

Since 2001 there has been a radio frequency identification (RFID) equivalent of the barcode standard, and all the advantages of a global open system are now available to RFID users also. The RFID standard is known as Electronic Product Code (EPC) and is administered world wide by GS1's wholly owned subsidiary EPCglobal, represented in New Zealand by GS1 New Zealand.

GS1 also offers the National Product Catalogue (formerly known as GS1net) an online product catalogue service that lets you enter, validate, store and maintain all your data in a single location. This information may then be automatically shared between trading partners. The National Product Catalogue is part of the Global Data Synchronisation Network (GDSN).

Other GS1 services include ProductRecallNZ enabling effective and efficient communication of recall and withdrawal information; and Product Photography ensuring high quality images of your products.

Information about these and other GS1 services and solutions is available online: www.gs1nz.org

2 GS1 New Zealand services for members

GS1 New Zealand works to support users and promote the use of the GS1 system in new environments and sectors. Services available include:

- GS1 New Zealand website www.gs1nz.org
- Global party information registry www.gepir.org
- GS1 Support Centre 0800 10 23 56
- GS1 Training
- Global traceability standards
- Barcode verification
- Expert consultancy
- ProductFlow
- ProductRecallNZ
- MedliaLibrary
- National Product Catalogue
- Product Photography
- Technical literature
- Web based product files

GS1 New Zealand has offices in Auckland, Wellington (head office) and Christchurch.

3 What do barcodes do?

All barcodes represent data in a machine readable form. The different widths of bars and spaces in a barcode symbol represent different numbers or letters which can be decoded by a barcode scanner. The data is then sent back to the appropriate computer system where it is recorded and used as a prompt for further action.

It is important to realise that numbers and barcodes are different things, and that there are hundreds of types of barcodes. When this booklet mentions barcodes it refers to barcodes that are part of the GS1 system. Because scanning systems can only decode those barcodes for which they have been set up, selecting the correct barcode to encode data is very important.

This booklet provides essential information about the printing and positioning of barcodes, but it is not intended as a replacement for GS1 specifications. These specifications are available free from GS1 Global www.gs1.org

Members are ultimately responsible for the quality of barcodes on their products and should ensure that they correctly specify all aspects of the barcodes they require when ordering print or packaging.

4 Industry requirements in Australia and New Zealand

The major grocery supermarket operators and hardware retailers in Australasia have jointly developed preferences for certain sizes and other aspects of barcodes on products supplied to them.

In addition, users should note that Woolworths have certain requirements of their own. Companies supplying the grocery trade should be careful to comply with these specific requirements as non compliant product may be rejected by the retailer.

All product offered for supply to grocery companies must be accompanied a GS1 barcode verification testing report. A growing number of hardware and other retailers are beginning to require these reports as well.

Note that some companies may have their own preferences or requirements within the range of technical options provided by GS1 specifications e.g. number of barcodes on a shipper, size of barcodes on some products. You should check your customers' terms of trade to be sure you comply.

For further information, contact the GS1 New Zealand Support Centre on 0800 10 23 56.

5 Number allocation

You are probably reading this because you need barcodes on your product. First you will need the identification number of each product to put in the barcode. Barcodes are just a means by which machines can read the numbers. The numbers in the barcodes are called Global Trade Item Numbers (GTINs). Correct terminology is important because numbers and barcodes are not the same thing and they have different names. The same number may be used in different barcodes. See Appendix 1, page 28.

Each variant of each product must have a separate GTIN and each level of packaging also needs to be identified with its own GTIN.

For example, a range of three jams sold in two jar sizes would need 3 (types) x 2 (jar sizes) plus 6 (cartons) = 12 GTINs.

Different GTINs must be allocated to each new product. Once in use GTINs must change if there is any change to the product.:

• That the customer or end user is expected to notice or should notice; or

• There is a legal or industry requirement that the new variant must be differentiated; or

• There is a logistical or handling significance in the change e.g. heavier, larger, more contents.

A GTIN that has been used once may never be reused on a different product.

For further guidance on number change decisions, see the GTIN Management Standard link on the GS1 Global website: www.gs1.org

Numbers on fresh produce for retail

Where a fresh product is to be sold at retail it is identified with a GTIN and barcode the same as a packaged product if the size and nature of the product permit. Otherwise it may be sold loose with no label at all or identified with a Price Lookup Number (PLU) printed on a small sticker. PLUs are not part of the GS1 system and stores using them will advise on their allocation. Sometimes a special small barcode called GS1 DataBar is used on a PLU label. It will contain a GTIN. See Appendix 7, page 51.

Special numbers

Sometimes you may need to put into a barcode a number that contains the weight or price of the product if it varies piece by piece e.g. a wedge of cheese or a fish fillet. The numbers used in these cases are not GTINs but Restricted Circulation Numbers (RCN). You should only use them if your customers request them or if you have first obtained your customer's agreement, because RCNs impose particular requirements on scanning systems.

There may also be products that will never be scanned by any company other than your own, so unique GTINs may be unnecessary because only you will ever scan them. In this situation you may use thirteen digit numbers in GS1 barcodes. For details on creating Restricted Circulation Numbers see Appendix 1, page 29.

Who is responsible for allocating GTINs?

Normally the company that owns the brand on a product is responsible for allocating GTINs to that product. This is best practice and minimises the potential for duplication or error.

What happens when a consumer unit is also a traded unit?

When a product is traded between companies and also sold at the retail point of sale, the product is both a traded unit and a consumer unit. Examples are a sack of potatoes, a toaster or a 12 pack of canned drinks. The same barcode serves both purposes but because it will be scanned in warehouses and distribution centres as well as in retail environments it needs to be larger than a barcode intended only for retail use.

What about GTINs from sources other than GS1?

GS1 cannot vouch for the uniqueness of numbers that have not been sourced from GS1 by the party currently using them. They are termed 'unauthorised numbers' by GS1 in the absence of a current GS1 authorisation for their use and are considered to be outside of the GS1 system. The terms of trade of most major grocery and hardware retailers in Australasia require GS1 compliance by suppliers because they rely on the GS1 standards and GS1 identifiers to support some business processes. The use of non GS1 numbers is not compliant. Please speak with your trading partner if you have a concern about this.

Number notification

Poor communication of item numbers between trading partners prevents effective handling of trade information. Following good practice will achieve immediate improvements at no extra cost.

- For proprietary branded products the manufacturer or supplier will notify the wholesalers or retailers of the GTINs being used
- For own brand products, the retailer or wholesaler will let the manufacturer know which numbers are to be used to identify new products

When a new product is being introduced, all the GTINs that relate to it must be notified to all the trading partners before the products are first supplied.

Reusing GTINs

Reuse of GTINs that have been released into the market is prohibited. A GTIN allocated during product development for a product that never entered the market may be reused after twelve months have passed but best practice is to disregard such a GTIN and allocate a new one.

This is because in the modern world, products may continue to exist and be listed online indefinitely even if manufacture is discontinued. Reusing these GTINs would confuse search engines.

Where to use the numbers

Obviously, you are going to put the number in a barcode. How to do this is explained in the next chapter. You will need to print the number in human readable form (Human Readable Interpretation - HRI) near the barcode. There are some rules about how to do this.

What about other countries?

The GS1 System is global. A correct GTIN and barcode from any country around the world is usable in any other country. If you have any difficulty persuading an overseas partner to accept your products with their GS1 New Zealand GTINs and barcodes, contact GS1 New Zealand for assistance. Note that Americans tend to call all retail barcodes UPCs and may be unfamiliar with our terminology.

6 Turning a GTIN into a barcode

Your label or packaging supplier will be able to print a barcode for you once you have given them the number. Print and packaging companies that are GS1 New Zealand members will be better equipped to provide you with accurate barcodes than non members.

GS1 New Zealand recommends the services of print and packaging companies that have completed the GS1 Accreditation Programme. Companies that are members are not automatically accredited. You are encouraged to ask your supplier about their GS1 membership status and their knowledge of current GS1 specifications, which may change from time to time.

Be sure to insist on full compliance with GS1 specifications including print quality requirements when you place the order for your print and packaging requirements. As the brand owner you are responsible for ensuring that the product reaches the market place with a correct barcode that will work reliably when retailers scan it.

You must create a product in MyGS1 to get a barcode. This process will give you the GTIN and the option to obtain a barcode graphic containing the GTIN.

The barcode graphic is intended for use by professional printers. It cannot be used in on-demand print systems e.g. thermal, ink jet. Users of on-demand systems should be able to create barcodes using the software in their equipment.

Forward the barcode graphic to your print or packaging supplier.

Members receive some free barcode graphic downloads each year (ten at the time of writing) and are charged a modest fee for each one thereafter. Barcode downloads are not available to non members.

GS1 New Zealand does not provide barcode printing equipment or software, although a list of suppliers is available on the GS1 New Zealand website www.gs1.org

Note that GS1 recommends that if you are scanning barcodes, you buy scanners capable of scanning two dimensional (2D) barcodes. These will be introduced within the lifetime of scanners purchased now.

GS1 New Zealand does not provide barcode printing equipment or software. A list of suppliers is available on the GS1 New Zealand website. www.gs1nz.org

7 The ideal barcode

The following pages provide a broad overview of the main requirements for a barcode. For greater detail see Appendix 1, page 28. The ideal barcode is one that represents the correct data and is scannable when printed within the allowable range of sizes.

Barcode size is usually expressed as a percentage based on a theoretically ideal 100% size. It is sometimes expressed as the width of the thinnest bar or space in the barcode, known as the X-dimension. The GS1 specifications provide a basis for determining the correct size of a barcode symbol and also recommend the use of verification equipment which assess barcode quality and give an indication of how well it will be scanned in practice.

The correct barcode symbol must be chosen before including it on the packaging of the product. If supplying the grocery industry in Australia or New Zealand be careful to comply with the specific requirements of that industry. See Summary of best practice recommendations, page 24.

For consumer units

Scanners at the retail point of sale are usually capable of scanning EAN-13, UPC-A, EAN-8 and UPC-E barcodes only, so one of these symbols must be used unless the customer has requested another.

> Most New Zealand users will use EAN-13 barcodes on their products (or EAN-8 barcodes for very small products).

The four retail barcodes, EAN-13, UPC-A, EAN-8 and UPC-E are generally known as 'EAN/UPC', or simply 'retail barcodes.' All four will work anywhere in the world. Some retailers can also scan GS1 DataBar barcodes.

- Barcodes should be clearly visible, in the same location on all similar shaped products and sized as indicated in Appendix 4
- One barcode is sufficient for a consumer units. See Appendix 2, page 32
- The barcode should be no closer than 8mm to a seam, edge or packaging fold
- The barcode should be on a flat or consistently curved surface
- The barcodes on consumer units should not be visible through the outer packaging of a six pack or other grouping of products
- For small cylindrical products, the barcode should be positioned vertically (ladder orientation) so that the bars are horizontal.

'Picket Fence' orientation
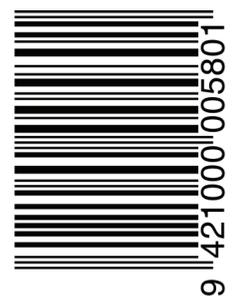
'Ladder' orientation

For traded units (shippers, cartons, etc)

Scanners at inward goods and in wholesale are designed to read retail barcodes as well as ITF-14 and GS1-128 barcodes so any of these may be used. The symbols used on very small products, the EAN-8 and UPC-E barcodes, will not generally be used on traded units.

Traded units may be handled automatically by inward goods systems and so the barcodes must normally be printed so that the bars of the symbol are vertical when the unit is in its normal storage position. GS1 can advise on the small range of exceptions in special cases. Traded units will often be sold intact at a wholesale point of sale, so it is very important that the barcodes on the consumer units inside them cannot be scanned through the packaging material.

At least two barcodes should usually be provided on each unit. One barcode should be on a short side and the other on the adjacent long right hand side. Note that the required number of barcodes may vary according to the sector or company you are supplying. See Appendix 3, page 34

- The barcodes on consumer units inside the outer case should not be scannable through the outer packaging
- The barcodes must be horizontal, in 'picket fence' orientation, so that the bars are vertical
- The minimum height of the bars in the barcode should be 32mm but there is no maximum height.
- Barcodes should be positioned so that the bottoms of the vertical bars are 32mm above the unit base.
- The barcodes including their light margins must be no closer than 19mm to a vertical edge
- The barcodes must not be obscured by any final packaging. See Section 12, page 21.

For logistics units, for example pallets

Scanners used to read labels on logistics units are capable of reading GS1-128 barcodes. See Section 9, page 14.

All the barcodes on the logistics label must be GS1-128 barcodes, unless they are two dimensional (2D) barcodes used according to GS1 standards.

- There should be two identical labels on each unit unless your customer specifies otherwise
- Label/s should be placed on forklift entry side/s
- The lowest barcode on a logistics label should be situated 400-800mm from the floor on which the unit stands (not the base of the unit)
- The barcodes including their light margins must be no closer than 50mm to a vertical edge
- The minimum height of the bars of all the barcodes should be 32mm
- The barcodes must be horizontal, in picket fence orientation, so that the bars are vertical.
- If the unit is less than a metre high see Position of label on pallet, page 16.

Barcodes on trade units and logistic units

Where there is a need for a barcode that contains more than the GTIN, e.g. where a weight or use by date is required, a barcode called a GS1-128 barcode is normally used. See 'Using GS1-128 barcodes' in Appendix 3, page 39.

Barcode size

It is important to determine the correct size for the intended use of the barcode, and for the choice of substrate and printing technique. More details are provided in Appendix 5, page 45.

Grocery companies require evidence of verification before accepting new products.

The use of verification equipment is recommended to check barcodes, especially when artwork has been created digitally. Verifiers are special scanning systems that scientifically assess barcode quality and initial verification can be done on artwork. This does not remove the need for verification of the printed product. The printing process will have changed the reflective characteristics of the barcode from its artwork form.

It is recommended that the barcodes on the finished products are verified to ensure that all the production processes have resulted in scannable barcode symbols. Verification equipment meeting the requirements of ISO/ IEC 15426-1 should be used, as it will provide a check on all of the print related criteria.

For more information about verification, see Sections 10 to 12, pages 17 to 22.

Verification is strongly recommended because wholesalers and retailers are increasingly using automated scanning systems in their supply chain. Poor quality, unscannable, barcodes create additional cost and delay for their operations. Grocery companies require evidence of barcode verification before accepting new products.

Barcode colours

Barcodes must be printed so that the darker bars appear on a lighter background. Scanners detect the colour contrast between the bars and spaces using red light, and it is important to use colours that will maximise this contrast. Because most scanners use red light, they see colours in ways humans do not.

Beware the product colour showing through transparent or semitransparent material and affecting barcode colour. Black bars on a white background are a good combination, but other colours may be used provided the bars have a high blue, black or green content and are printed on a background that is white, yellow, orange or red. The illustrations on the next page show examples of scannable and non scannable colour combinations.

Verifiers that meet the requirements of the international specification ISO/ IEC 15426-1 are able to measure the contrast of a printed barcode, and they should be used to check that particular colour combinations are scannable.

Any colours used for the printing of the bars must be pure or 'spot' colours, and not printed out of the conventional four colour (CMYK) process.

GS1 can advise on colour combinations you may be considering.

Barcode colours

Because scanners use red light, only certain colour combinations can be used.

Scannable

Non scannable

5 012345 678900 >

5 012345 678900 >

5 012345 678900 >

5 012345 678900 >

8 Choosing the correct barcode

Will the unit be sold through a retail Point-of-Sale?

Yes (e.g. can of baked beans)

Possibly (e.g. carton of wine)

No (e.g. carton of cans of baked beans)

Recommended

Optional *

Is this unit big enough to accommodate an EAN-13 barcode?

Does the barcode need to contain supplementary data such as batch number or use by date?

Yes

No

Yes

No

Contact GS1 to apply for an EAN-8

Use GS1-128

Use ITF-14

Does the barcode need to contain supplementary data such as batch number or use by date?

Does the barcode need to contain supplementary data such as batch number or use by date?

Yes

No

Yes

No

You may need a special type of barcode. Contact GS1 for advice

Use EAN-13

This unit is too small to accommodate the barcodes you need. GS1 DataBar may be an option.

Use EAN-8

See Appendix 7 for information about GS1 DataBar

* Note: This option means that the barcode you use can not be scanned at retail. Operators will have to open the carton, scan one of the items inside, and manually enter 'x12', 'x24', etc to indicate the number of units in the carton.

All Canadian and United States retailers are now able to scan EAN-8 and EAN-13 symbols. If exporting, check with your agent. Note that Americans generally refer to all retail barcodes as 'UPC', but may mean EAN/UPC, which includes EAN-8 and EAN-13. Contact GS1 for assistance if your American partner disagrees with your use of EAN barcodes.

9 Logistics labels - Serial Shipping Container Code (SSCC)

Pallets and other transport units must be labelled with a GS1 logistics label. The term pallet label is often used but not all logistics units are pallets. An example is on the next page. The number used is a unique tracking number called a Serial Shipping Container Code (SSCC). Do not confuse this with the American term Shipping Container Code (SCC). See Glossary of Terms page 26.

The X-dimension for the GS1-128 barcodes shown here is 0.495 mm, and this is the minimum that should be used. This is equal to a magnification of 50%.

The GS1 specifications stipulate that GS1-128 barcodes must be used on these labels to represent the GS1 data.

The most common label size is close to A5, which is 148mm wide and 210mm tall. If less information is required, some companies will choose to use a label size closer to A6 which is 105mm wide and 148 mm tall. The actual size of the label will depend on the requirements of the trading partners, and any size of label may be used.

The label uses GS1-128 barcodes and provides information that will be useful to all the participants in the transport and distribution chain.

- Each shipping container, transport unit or pallet is identified with a unique tracking number called a Serial Shipping Container Code (SSCC)
- The SSCC is an 18-digit number that is unique for each unit
- The SSCC is specified by the AI(00)*
- The barcode containing the SSCC should always be the lowest barcode on the label and must always be printed at 50% magnification or more

In addition to the SSCC most users will provide details of the contents of the pallet.

- Use AI(01) to give the GTIN of the cases on the pallet if the pallet has a pre-defined quantity of cases, and it is a traded unit. AI(01) must not be used together with AIs(02) and (37)
- If the number of cases on the pallet is not pre-defined use AI(02) to give the GTIN and then AI(37) to provide the quantity. AI(37) must always be used when AI(02) is used
- Use whichever extra AIs you need to provide extra information for yourself or your trading partners, for example, AI(400) for purchase order number
- The height of the bars of all the barcodes should be a minimum of 32mm

Two labels will be required for each pallet and they must both bear the same SSCC.

GS1 Print Tool

GS1 Members can access GS1's online Print Tool to generate SSCC logistics labels for pallets. This can be accessed via MyGS1. Contact GS1 Support Team to learn more.

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* Note: AIs (Application Identifiers) are digits in parentheses placed in front of sets of numbers in a long string of data to indicate what each part of the string means. They are explained in detail in Using GS1-128 barcodes, page 39

A5 sized label example

GRAND SUPPLIER COFFEE

SSCC
0 0614141 1234567890

CONTENT
00614141000418

COUNT
20

BEST BEFORE (DD.MM.YY

28.02.21

BATCH/LOT

451214
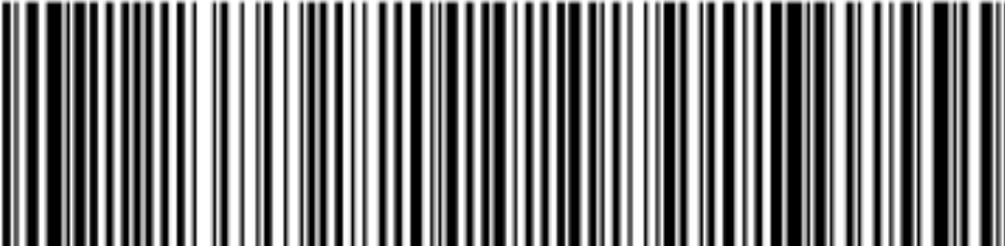
(02)00614141000418(15)210228(10)451214(37)20
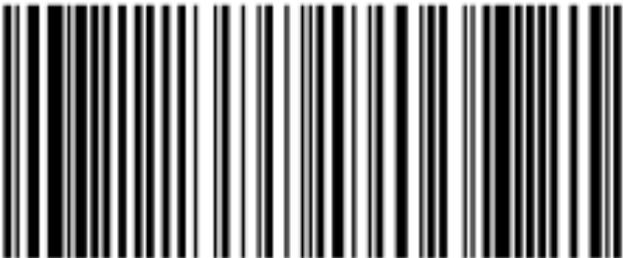
(00) 0 0614141 123456789 0

Position of label on pallet

Many pallets will be handled on automatic systems so it is important that scanners can find the barcodes easily.

For pallets taller than 1 metre:

- Place the label so that the barcodes are no higher than 800mm and no lower than 400mm, measuring from the floor on which the pallet stands, not the floor of the pallet

- Use two identical labels for each pallet, one on a short side and one on the long right hand side as shown below (GS1 recommendation) but confirm with your customers as some prefer opposite sides.

- Ensure that the barcodes including their light margins on the label are no closer than 50mm to a vertical edge

For pallets less than 1 metre in height:

- Place the label as high as possible but make sure that the barcodes are no higher than 800mm and no lower than 32mm from the base of the unit

- Ensure the barcodes with their light margins are no closer than 50mm to a vertical edge
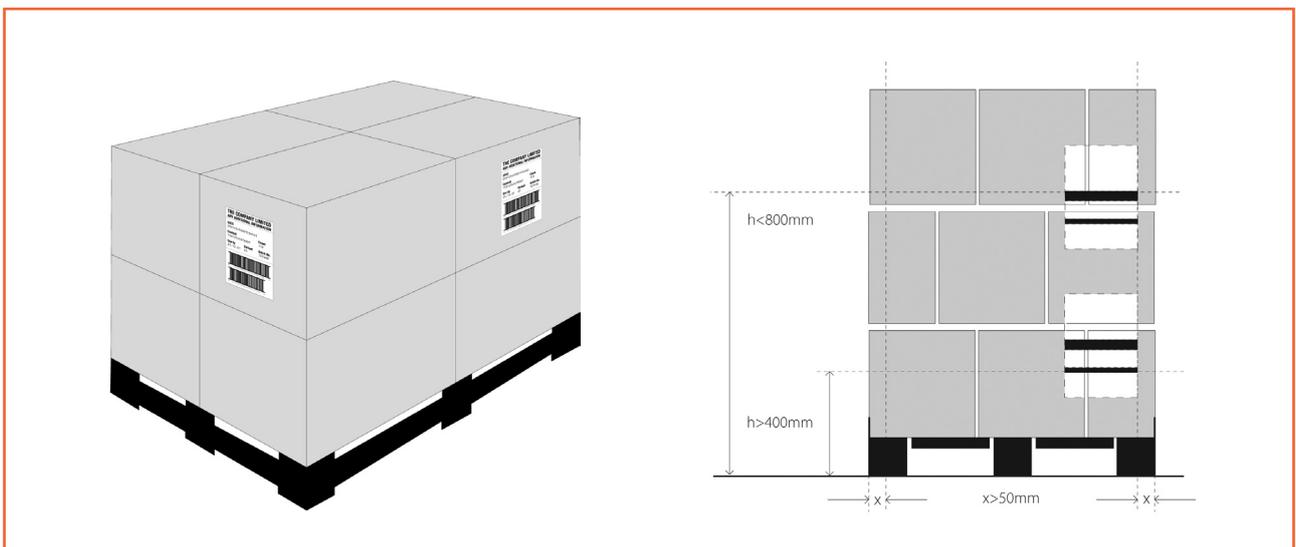
10 Barcode verification process

The accurate printing of barcodes is fundamental for effective value chain management. Manual data capture and entry is necessary when barcodes fail, which causes delays and errors. Number errors will cause problems even when barcodes scan well or manual entry succeeds.

Barcode scanning provides no indication of barcode quality, because scanners perform differently. It is possible for one scanner to scan a barcode that another scanner can not scan. Only a verifier will reliably test barcode quality and only GS1 verification will test the correctness of the number.

Verification equipment grades barcodes on a four point scale. For GS1 purposes a grade of 1.5 is considered a 'pass', although a higher grade is always desirable. ITF-14 barcodes printed at or above a size of 62.5% are 'passed' at a grade of 0.5.*

It is possible for one scanner to scan a barcode that another cannot scan. Only a verifier will reliably test barcode quality.

* Note: Woolworths requires a minimum grade of 1.0

Image supplied by **Axicon Auto ID Ltd**

11 GS1 barcode verification reports

A GS1 barcode verification report details the correctness of a barcode in terms of the GS1 specifications. These reports are not the same as the reports printed off by proprietary verification equipment. GS1 verification reports produced by GS1 in New Zealand or Australia are recognised in both countries.

Using GS1 accredited printers ensure your barcodes meet GS1 specifications. The supplier remains responsible for obtaining the final GS1 verification report.

How to apply for a barcode verification report

To apply for a barcode verification report visit MyGS1 and click on 'Apply Now' for a GS1 Barcode Verification.

The system will send you an email acknowledging your application and providing the address to which the sample should be sent. Print a copy of the email and enclose it with the sample of the product that you courier to GS1 for testing. If you are sending electronic images, email verify@gs1nz.org with the images and barcode dimensions attached.

Preferably consumer units should be complete, made up and filled as for sale. Inners and shippers may be folded and empty but should be entire so that testing staff can reassemble them to assess the correctness of the barcode location. Be careful not to fold across barcodes as creases can affect test results. Products sent for testing are donated to charity unless their return is requested. Items will be returned at the members expense if requested.

Where a report is required before final barcodes are printed GS1 will report on artwork of proposed labels or packaging. Proofs should be sent by post or courier, as for finished barcodes. Artwork may be sent electronically, preferably in PDF format to: verify@gs1nz.org

Reports on artwork will be endorsed with the word 'interim' and must be followed by a report on a finished barcode no more than six weeks after the initial test.

Note: Verification of artwork is a useful check for correctness during the pre-press stage of artwork production and is recommended for that purpose. It is not complete assurance that the final product will pass verification however. Verification tests, among other things, the reflective properties of a barcode and these will change with different printing materials and methods. A proof may have reflective properties different to those of the final label or package.

GS1 New Zealand members receive some free tests each year and a small charge per test applies thereafter. Non members are charged for all tests. Details of current charges are available from GS1 New Zealand.

> Suppliers remain responsible for obtaining the final GS1 barcode verification report

12 Common problems to avoid

These are many of the most common problems, and some that will be discovered with the correct use of verification equipment.

Examples	Problems
	The light margins required for each barcode symbol are not large enough.
	The barcodes are unnecessarily shortened below their specified height (truncation).
	Missing bars or horizontal white lines crossing the barcode because of faulty print heads used for on demand printing.
	Choosing incorrect colour combinations, often orange or red bars on a pale background, which will not scan. Negative images, where the bars are white against a darker background, are also not scannable.
	Using transparent or semi transparent substrates, such as glass or plastic, and hoping that the contents will provide a suitable background colour either for the bars or the spaces.
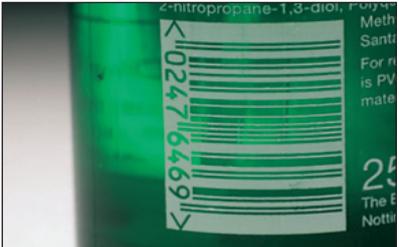
Examples

Printing barcodes that are either too large or too small.

Incorrect adjustment for ink spread (the bar width reduction). The printed bars are out of specification, either being too narrow or too wide.

Printing ITF-14 barcode (right) without bearer bars.

Placing labels too close to vertical corners or wrapping them around corners so that the barcodes are too close to the edge.

Peeling or creased labels.

Show through of the barcodes on consumer units through the outer packaging.

Examples	Problems
	Printing barcodes onto film which is distorted as it is used as shrink wrap.
	Obscuring the barcodes.
	Barcode printed vertically. Generally a fault but exceptions may be permitted (Consult GS1)
	Barcode printed too close to edge of label.

Examples	Problems
	Same GTIN on different product lines.
	Printing barcode on to packaging or a label which is then distorted.
	Poor quality substrates are substituted for the original specification, resulting in loss of quality, often greater ink spread, or the appearance of voids in the bars. A darker coloured substrate, for example, could result in insufficient contrast.
	Using uncovered metal surfaces as a background or for the bars of a symbol. The specular reflectance of the substrate can cause problems, and a solid background should be printed to provide contrast and eliminate this problem.

Problems with GS1-128 barcodes

Printing Code 128 symbols instead of GS1-128 symbols.

Encoding the parentheses around the application identifiers as data within the barcode symbol. These parentheses are only used around the application identifiers in the human readable characters printed below the barcode.

Not showing the application identifiers in parentheses below the barcode.

Not including the application identifiers required to define the data in a barcode.

Printing a GS1-128 symbol wider than 165mm. This dimension includes the light margins which are not explicitly indicated, so special attention must be given.

Not listing application identifiers in the recommended sequence. Fixed length identifiers should go before variable-length, for faster decoding and to conserve label space.

13 Checklist

All of the following must be checked. Read in conjunction with the summary on page 24.

1. Check that the GTIN is the one assigned to the product.

2. Ensure that the check digit is correct.

3. Check that the symbology you have selected is appropriate for the intended use – retail, distribution, retail and distribution, or logistics.

4. Check with a verifier or an ordinary scanner that the number you intend to use is the one encoded in the symbol.

5. Check that the symbol is being produced at a size that is within the specified size range for its type and that the bar height and light margins are correct.

6. Ensure that you have complied with any industry or trading partner requirements as to the size or number of barcodes on your products.

7. Throughout the printing process use a verifier – not a scanner – to verify symbol quality to at least the ISO standard grades specified on page 24. Ensure that the contents of the packaging will not affect the contrast between the bars and spaces.

8. Check that the shape of the product inside the package does not distort or otherwise affect the barcode.

9. Ensure that no shrink-wrap, tape or other printing will obscure the barcode symbol on the finished product.

10. Ensure that no other barcode symbols will show through from the inside of the pack.

11. Carry out routine verification at all levels of packaging to ensure that the barcode complies with the required quality standard, and to identify any potential problems.

12. Keep records of verification for the shelf life of the product.

13. Notify trading partners of the GTINs and the products they identify in good time.

14. MyGS1 will be your record of the GTIN and the product to which it is assigned.

Verification to the ISO Standard, sometimes referred to as the ANSI Standard, is the only correct test of quality for GS1 barcodes.

Ordinary scanners do not test barcode quality.

14 Summary of best practice recommendations

	EAN-8, EAN-13, UPC-E or UPC-A	ITF-14 printed on label	ITF-14 printed on board	GS1-128
Consumer unit	✔			
Traded unit	EAN-13 or UPC-A only ✔	✔	✔	If variable data required ✔
Number of barcodes on consumer unit[1]	1			
Number of barcodes on traded unit (GS1 specifications)	4 (pref) 1 (min)	1	4 (pref) 1 (min)	1 (if on a label)
Number of barcodes on traded unit[2] (Aust/NZ grocery industry requirements)	6 (pref) 2 (min)	2	6 (pref) 2 (min)	2
Range of X-dimension sizes	0.264mm to 0.66mm[3]	0.495mm to 1.016mm	0.635mm to 1.016mm	0.495mm to 1.016mm
Magnification range (GS1 specifications)	80% to 200%[4]	50% to 100%	62.5% to 100%	50% to 100%
Magnification sizes (Aust/NZ grocery industry requirements)	80% to 200%[4]	50% to 100%	100%	50% to 100%
Bar height for consumer units[5]	depends on size, see Appendix 4a			
Minimum bar height for traded units[5]	depends on size, see Appendix 4	32mm	32mm	32mm
Bearer bar[6]	Optional - recommended	Mandatory top and bottom	Mandatory right round	Optional recommended
Optional light margin indicators[7]	YES	YES	YES	YES
Minimum ISO verification grade[8]	C	C	D[9]	C

1 More than one symbol may be used if necessary, but the practice is not encouraged. If product is heavy or bulky, more barcodes are advised. Where more than one symbol is used symbols should be as close together as possible and in no case further apart than 150mm.

2 Woolworths require 6 if retail barcodes or ITF-14 printed on board are used.

3 A minimum X-dimension of 0.25mm is allowed for on-demand barcode production.

4 A minimum magnification of 75.8% is allowed for on demand barcode production.

5 There is no maximum bar height. Barcodes may be printed as tall as the user wishes. Over height barcodes may be helpful in overcoming problems of packaging shape or texture by providing a greater area of potentially scannable barcode

6 Bearer bars are mandatory when printing ITF-14. They are useable with all types of barcode when printing with plates and will be helpful in achieving good quality in any case where printing is directly on to corrugated board. GS1 recommends using bearer bars whenever barcodes of any type are printed on corrugated board.

7 Light margin indicators are not formally required but they may be used to provide a visual indication of the space required to the left and right of each symbol.

8 Note that even where grades are the same different scanner apertures must be used on verifiers testing different barcode types. Ensure that the verifier operator is aware of these requirements and uses the correct aperture for each type.

9 Woolworths require a minimum ISO grade of 1.0/20/670.

Notes

1. Ensure EAN-13, UPC-A, EAN-8 or UPC-E barcodes are used on any product that might be sold at a retail point of sale. Be aware of GS1 DataBar (Appendix 7, page 51) and the possibilities it may offer you.

2. If a traded unit might also be sold at a retail point-of-sale, it must be barcoded with an EAN-13 or UPC-A barcode of between 150% to 200% magnification (equal to an X-dimension of at least 0.495mm). The actual size chosen will depend on the choice of printing materials being used.

3. GS1 specifications state minimum barcode heights. There is no objection to printing over height barcodes. This can be prudent on soft packaging where parts of the barcode may be distorted during handling.

4. Traded units can be barcoded with any of these symbols – EAN-13, UPC-A, ITF-14 or GS1-128. Short shelf life traded units (those with a shelf life of less than 90 days) will need to be barcoded with GS1-128 barcode including the best before or use by date.

5. Inners may be barcoded with any GS1 barcode or with none, as agreed between you and your trading partners. If you do not know your trading partners' preference, assume that barcodes are required.

6. Remember that the light margins of any of the barcodes vary in proportion when you increase or decrease their size. Ensure that the light margins you provide at each side of the barcode will be adequate. Allowing extra width over and above the stated minimum is good practice to allow for movement during printing.

7. When printing any of the GS1 barcodes on demand, incorporate horizontal check bars that will allow you to see easily whether any print head elements are failing. These may be placed above or below the symbol.

8. Make sure it is not possible to scan any of the barcodes on individual items when they are inside any outer packaging.

15 Glossary of terms

Terms	Meaning
Australian Product Number (APN)	(Obsolete and never correct, should not be used) A term used (wrongly) for GTINs when the GS1 System was launched in Australia and GS1 Australia was called the Australian Product Number Association.
Automated scanning	Scanning in a warehouse or distribution centre that has moving conveyors with scanners mounted alongside.
Automatic Data Capture (ADC)	The use of technology such as barcodes or radio frequency identification to automatically read numbers, text or symbols and enter the data into systems.
Application identifier (AI)	The 2, 3 or 4 digit number that specifies the data that immediately follows it in a GS1-128 barcode or number string. For example AI(21) means 'serial number' hence (21) ABC123.
Article number	The former name for the GTIN.
Bearer bars	The bars that surround an ITF-14 symbol to equalise the pressure exerted by the flexographic printing process over the entire surface of the symbol. Bearer bars are mandatory on all four sides of ITF-14 symbols printed with plates and at the top and bottom of ITF-14 symbols printed by other methods. They are optional with other types of barcodes but will always help improve print quality when printing on corrugated board.
Check bars	Horizontal bars printed above any of the barcodes when they are printed on demand that will indicate any missing print head elements.
Consumer unit	An item that maybe sold at a retail point of sale. Also known as a retail trade item.
Dispatch Unit Number (DUN)	(Obsolete, should not be used) A term once used in Australia only for GTINs on traded units (see TUN).
EAN-8	The barcode that represents a GTIN-8
EAN-13	The barcode that represents a GTIN-13.
EAN•UCC	The former name of the international system, prior to the Uniform Code Council/ EAN International merger in January 2005. It was generally known as 'The EAN System' outside the US and is now universally known as 'The GS1 system.'
EAN/UPC	The name of the symbology used by EAN-8, EAN-13, UPC-A and UPC-E barcodes. Used to generically refer to the four GS1 barcodes used in retail.
Global Company Prefix (GCP)	The combination of country indicator and GS1 membership number that provides the first part of every GTIN created by a user of the GS1 system.
GS1	The governing body of the GS1 system. See Page 1.
GTIN	Global trade item number. The unique number for a product variant. This number is used in a barcode and electronic data interchange messages.
GTIN-8	The name given to the 8-digit GTIN that is shown in an EAN-8 or UPC-E barcode. Formerly known as EAN-8.
GTIN-12	The name given to the 12-digit GTIN formed from a prefix allocated by GS1 US prior to January 2005, and shown in a UPC-A barcode.
GTIN-13	The name given to the 13-digit GTIN usually shown in EAN-13, ITF-14 or GS1-128 barcodes. Formerly known as EAN-13.
GTIN-14	The name given to the 14-digit GTIN usually shown in either ITF-14 or GS1-128 barcodes on traded units. Formerly known as EAN-14.
Hand scanning	Scanning with a scanner held in the hand
Item Number	Global Trade Item Number, the new term that has replaced article number.
ITF-14	Interleaved Two of Five 14. The barcode symbol used to show EAN-14 numbers on trade items not crossing a retail point of sale. ITF is not exclusively a GS1 barcode and is used in many applications.

Terms	Meaning
Kraft	A coarse brown paper used for heavy paper bags and making corrugated board.
Ladder orientation	Printing the barcode with the bars horizontal to the base of the product.
Light margins	The clear spaces required to the left and right of any barcode symbol. These differ for each barcode symbol as shown in Appendix 1. As a general rule the width of the light margin will be 10 times the X-dimension or thinnest bar in the barcode.
Light margin indicators	< and/or > marks to indicate the light margins required.
Magnification	An expression of the size of a barcode relative to a theoretical standard size called one hundred percent.
Module	The smallest element (i.e. thinnest bar or space) of a barcode.
Omnidirectional scanning	Scanning by the type of scanner used in supermarkets, service stations and some hardware stores. It projects a pattern of beams in many directions at once.
Outer case (Outer)	Alternative term for a traded unit.
Pallet label	The GS1 logistics label that is used to track and identify pallets and any other transport units.
Picket fence orientation	Printing a barcode so the bars are vertical to the base of the product.
Quiet zones	Another term for light margins.
Retail Trade Item	See 'Consumer Unit'.
Shipper	Alternative term for a traded unit.
SCC	(American terminology) Shipping container code. A GTIN and/or barcode used on a traded unit. Depending on context the user may intend to refer to the GTIN or the symbol. Do not confuse with SSCC
SSCC	Serial shipping container code. The unique 18-digit identifier for a transport unit.
Substrate	The material on to which a barcode is printed.
Symbol	Barcode symbol.
Symbology	The type of barcode symbol.
Trade item	Any item that is identified for pricing, ordering and invoicing purposes. This includes both consumer units and traded units.
Traded unit	An item that is priced, ordered and invoiced between manufacturers, retailers and wholesalers. Also known as an outer case or a trade item not crossing a retail point-of-sale, shipper or carton.
Trade (or Traded) Unit Number (TUN)	(Obsolete, should not be used) A term once used in Australia only for GTINs on traded units (See DUN)
Truncation	Reduction in height of a barcode symbol when its width is unaltered.
UCC	Uniform Code Council (now GS1 US). The American organisation that formerly coordinated the GS1 System in the USA. In January 2005 EAN International and the UCC merged into GS1.
UPC-A	The name given to the barcode used to encode a GTIN-12.
UPC	Universal Product Code. Used to describe the UPC-A barcode that represents a GTIN-12. Note: American users may use the term 'UPC' incorrectly to refer to any retail barcode, so it is important to clarify their intentions when the term is encountered.
UPC-E	The name given to the barcode used to encode a shortened GTIN-12 with 8 digits. Equivalent of EAN-8.
X-dimension	The nominal dimension of the narrowest bars or spaces in a printed barcode.
YYMMDD	Year-year, month-month, day-day, the format in which dates are expressed in GS1-128 number format. All six digits must be used with zeros filling any spaces that may not be required.
Zero suppression	A process that enables some specially formulated GTIN-12s to be reduced to an 8-digit form for use in UPC-E barcodes.

Appendix 1 Obtaining GTINs and creating SSCCs

Global trade item numbers (GTINs)

GTINs are unique numbers that are used to identify every different product line. Every user should ensure that their database can record 14-digit GTINs as these numbers may be used on products that are supplied to them, even if a user decides not to create 14-digit numbers. This is especially important because the introduction of GS1 DataBar may mean 14-digit numbers will be used at the retail point of sale.

GTIN-14s, to give 14-digit numbers their correct name, are explained in more detail below. They are usually shown in either ITF-14 or GS1-128 barcodes but are also used in GS1 DataBar and two dimensional barcodes (GS1 DataMatrix and GS1 QR Code).

When any GTIN is recorded in a database, it should be treated as a fixed length 14-digit number. Where the original GTIN is less than 14-digits it should be extended by placing zeros in front of it to create a total of 14-digits.

Obtaining GTINs

Affiliate users will be given their numbers by GS1 on registering.

If you joined GS1 New Zealand after December 2020:

- On the GS1 New Zealand website (www.gs1nz.org) select 'log in'
- Log in using the details you were provided on joining GS1
- Select 'MyProducts'
- Under 'Get started' select 'Get a barcode for my product'
- Select the hierarchy level – base for retail item, etc.
- On the screen that will appear;
    - Enter the brand (this will be saved and can be selected next time)
    - Enter product details as required
    - Enter all countries in which the product will be sold
    - Upload an image of the product (optional)
    - The system defaults to 'Save to GS1 Global Registry'
- Select 'Save and submit'
- Review the data that will be displayed and edit if necessary
- Once satisfied select 'Confirm and continue'
- The GTIN allocated by MyProducts will be displayed at this point
- Select 'download barcode'
- The barcode symbol will be downloaded in pdf to the user's computer
- The screen will display these options;
    - View product data – displays the data just entered
    - Add packaging level – for the higher levels of packaging requiring GTINs
    - Create another product – to repeat the process for a different product
    - View all products – to see all of your products and their data
- Select as required or quit

If you joined GS1 New Zealand before January 2021:

• On the GS1 New Zealand website (www.gs1nz.org) select 'Log in'
• Log in using the details that will have been provided on joining GS1
• Go to 'Barcodes'
• Select 'Enter product information for a single new GTIN'
• Enter the details of each product and specify 'base unit'
• MyGS1 will allocate a GTIN to each product
• Use the thirteen digits commencing '94' as GTIN-13 on retail items
• Use a zero in front of '94' to make up GTIN-14 for cartons, shippers etc
• Select 'Barcode generator' after obtaining the GTIN for each product
• The generator will open with the GTIN already entered
• Select the required barcode – EAN-13 for retail items, ITF-14 for shippers cartons etc.
• Select 'email me my barcode'
• Forward the email to packaging or print suppliers

Exporting to the USA and Canada

Companies with established customers in North America may also have a prefix allocated by GS1 US, previously known as the Uniform Code Council. If so, they should continue using that prefix as before to create UPC numbers. Companies establishing new relationships in North America can use their GS1 New Zealand GTINs from MyGS1 in the US and Canada as for any other market. All North American retailers have been enabled for EAN-13 and EAN-8 barcodes since January 2005. If any problems arise in this regard contact GS1 New Zealand.

Note that most Americans will continue to use the term 'UPC' to refer to retail barcodes when in fact EAN-13 and EAN-8 will also be acceptable. Clarify American partners' use of the term 'UPC' before assuming that they cannot in fact accept EAN-13 or EAN-8.

If EAN-13 barcode is too big

If you think that an EAN-13 barcode will not fit on your product contact GS1 New Zealand to discuss whether you qualify for GTIN-8s that can be encoded in smaller barcodes. Note that GTIN-8s are a limited resource. They will be issued only when absolutely necessary and will not be issued simply to satisfy design preferences.

Special cases

Not all products fit neatly into the general principles of the GS1 System.
The following cases require some degree of variation.

• Wine may be identified by variety and vintage or simply by variety as agreed between the winemaker and customer

• Publications may be identified by standard GTINs or by International Standard Book Number (ISBN) or International Standard Serial Numbers (ISSN) that have been converted to GTINs. Sometimes videos, DVDs and CDs may, depending on their contents, be defined as 'publications' eligible for ISBN numbering. Consult the National Library or GS1 for details

• Discount coupons may be identified by a GTIN that uses 99 in place of the 94 in the prefix

• Customer cards may be identified in the manner described for 'own label' products below

Identifying variable measure items using restricted circulation numbers (RCN)

Some products vary constantly so that each one is different from the others. An example is sliced ham from a delicatessen where each customer pays a slightly different price because each purchase weighs a different amount. Retailers that sell these items are equipped with printing scales that weigh items and produce barcoded labels for them in store.

Numbers that are used within a single store or other managed environments are called restricted circulation numbers (RCN).

Options exist for manufacturers to generate RCNs that express the identity and price or weight of individual items. These numbers are restricted to the manufacturer and those customers that have agreed to accept the products involved. Do not use them without the knowledge and consent of your customers.

Identifying variable weight items using restricted circulation numbers (RCN)

Manufacturers of variable weight products should apply to GS1 for a 3-digit manufacturer identifier. They must then assign a 2-digit identifier to the product. Most printing scales will then create a 1-digit check digit, but if not, this space should be filled with a zero. There will then be four digits available to express the weight in grams and finally a check digit calculated the same way as all GTIN check digits. The software on printing scales will do this calculation for you after you input the first twelve digits.

Prefix	Manufacturer ID	Item ID	Scales check digit	Weight (gr)	Check digit
29	XXX	XX	X	XXXX	C

Identifying variable weight items by retail price using restricted circulation numbers (RCN)

This method requires the manufacturer to know the price for which their customer will sell the product. It is therefore difficult to implement and is rarely used in New Zealand. Identifying by weight and leaving it to the retailers point of sale system to translate the weight to a price is the simpler method for manufacturers.

Prefix	Manufacturer ID	Item ID	Scales check digit	Price (cents)	Check digit
02	XXX	XX	X	XXXX	C

Users who need to create variable measure RCNs will be using label printing equipment that produces different numbers for each item labelled. They should have been instructed in the use of the RCNs by their equipment supplier. GS1 can advise on this matter.

Identifying own label products using restricted circulation numbers (RCN)

Where a product is manufactured for retail under a house brand in a situation where it will only ever be sold through one company's outlet and recorded only in that company's databases, the usual GTIN creation rules may be waived. 8-digit or 13-digit long RCNs may be made up however the user wishes using the digit 2 to begin the number. Note however that the combinations 26 and 29 may not be used in the GTIN-13 format as these combinations occur in other specialist numbers that may be encountered in the marketplace.

Prefix	Item ID	Check digit
2	XXXXXXXXXX	C
2	XXXXXX	C

Obtaining shipper GTINs (GTIN-14)

If a shipper is intended for sale intact as a retail item e.g. a carton of beer it must be identified with GTIN-13 in an EAN-13 barcode. However a unit used only for distribution should be identified with a GTIN-14 in a barcode suitable for distribution environments i.e. ITF-14 or GS1-128. The current method of acquiring GTIN-14s is to simply get a new GTIN-13 from MyGS1 and use it with the leading zero provided. Numbers made up in this manner are usable in GS1 DataBar, ITF-14 and GS1-128 barcodes.

> Serial Shipping Container Code (SSCC) should not be confused with Shipping Container Code (SCC), an incorrect term widely used overseas.

Creating serial shipping container code (SSCC)

The basis of a Serial Shipping Container Code (SSCC) is the user's Global Company Prefix (GCP). The GCP is the initial part of every GTIN allocated to a company and is assigned to members when they join GS1. Each company's GCP can be found on the company's MyGS1 page in the section titled Barcodes Allocated (GTINs). The GCP is the part of the GTINs illustrated in that section that appears in bold type e.g. 9412345000002 – 9412345999993 indicates a GCP of 9412345.

Free SSCC Tool
GS1 Members are provided with an online SSCC Barcode Generator Tool (GS1 Print) and is accessed through MyGS1.

Some members may have more than one GCP. This can happen where the company has bought other companies and taken over their GS1 membership or where the initial range of GTINs has been used up and another range purchased.   In such situations any of the assigned GCPs may be used to make up SSCCs.

The SSCC has four components but it should always be used as one complete number within companies' computer systems. Whenever an SSCC is shown in a barcode the application identifier (00) will precede it. The application identifier (AI) for SSCCs is always (00) and defines the data structure.

The extension digit can take any value between 0 and 9 and allows users to create more SSCCs. It was previously known as the packaging indicator but is no longer used for that purpose. Any digit may be used to fill the space. By convention most users use 3.

The serial number is between 7 to 9 digits in length, depending on the length of the GCP, and is allocated by the company making up the unit. The number must not be reused for at least one year or until the unit to which it was assigned has been broken down and no longer exists, whichever is the later.

Serial Shipping Container Code (SSCC) users will have label printers programmed to create sequential complete number, including check digit.

Application identifier	Extension digit	Global Company Prefix	Serial number	Check digit
00	X	XXXXXX	XXXXXXXXX	C
00	X	XXXXXXX	XXXXXXXX	C
00	X	XXXXXXXX	XXXXXXX	C
00	X	XXXXXXXXX	XXXXXX	C

Appendix 2 Barcodes on consumer units

Consumer units (items that may be sold at a retail point-of-sale) must be barcoded with EAN-13, UPC-A, EAN-8 or UPC-E symbols, and they are shown at right. GS1 DataBar is in limited use in retail but will become more common.

Whenever barcodes are made smaller or larger they should be kept in proportion. The height of the bars should not be reduced (truncated) unless absolutely necessary as truncation reduces the barcode's scannability.

UPC-A and UPC-E were the original retail barcodes developed in the US and until January 2005 were the only ones North American retailers could scan. They occupy the same surface area as EAN-13 and EAN-8 respectively. North American retailers can now scan all the retail barcodes.

The EAN-8 barcode represents a GTIN-8 that is directly assigned by GS1 New Zealand for the identification of very small items. If you think that an EAN-13 barcode will not fit on your product contact GS1 New Zealand to discuss whether you qualify for EAN-8 barcodes.

The UPC-E barcode contains a GTIN-12 that has been reduced to eight digits. As American retailers can now scan EAN-8 barcodes you will not need to know how to make up numbers for use in UPC-E barcodes.

However, if you are a retailer, your scanning system will need to be programmed to expand the numbers in UPC-E barcodes back to their 12-digit form.

These four symbols: EAN-13, EAN-8, UPC-A and UPC-E are collectively referred to as 'EAN/UPC' symbols, or 'retail barcodes'. The size chosen will depend on the printing process being used and the quality of the inks and substrates being used. provides detailed dimensions at various magnifications within the specified range.

All these barcodes are at 100% magnification.
(GS1 DataBar is not shown)

EAN-13

5 012345 678900 >

UPC-A

6 14141 00086 9

EAN-8

< 5012 3452 >

UPC-E

0 012345 7

EAN-8 barcodes are a limited resource. They will only be issued when absolutely necessary and will not be issued simply to satisfy design preferences.

Human readable numbers

The numbers that are in a barcode must appear in human readable form. Any clearly legible font is accepted. The preferred location is immediately below the barcode symbol, otherwise as near as possible to it and preferably to the left.

Main requirements

- The bars of the codes must not be truncated unless the product's size makes this absolutely necessary. There is no objection to over height barcodes
- Adequate light margins or quiet zones must be provided to the left and right of each barcode.

Sizes between 80% and 200% are allowed but note that if the unit will be used for distribution as well as retail sale the size requirements is 150% to 200% for traded units.

- Bigger barcodes are easier to print and scan than smaller ones so as a general principle users should favour larger size options.

When printing barcodes smaller than 100% remember that the printing tolerances are much tighter and you must use high quality printing processes. It is not always possible to improve the quality of the printing process so tests must be carried out before committing to a particular size of symbol.

X-dimension

When any of these barcodes are at its nominal or 100% size the width of the narrowest bar or space is 0.33mm. This measurement is also known as the X-dimension. The width of all bars and spaces must be exactly the X-dimension or two, three or four times the X-dimension.

Light margins or quiet zones

The clear spaces to the left and right of each barcode symbol are very important in separating the symbol from any nearby graphic or colour. Nothing should be printed in these areas except for the symbol's light margin indicators, if used. Light margin indicators are optional, but they are recommended to ensure correct light margins.

The minimum light margin dimensions are provided in Appendix 4b, page 44, but it is prudent to allow slightly more than this space at each side to allow for variation in printing tolerances and placement. Light margins can be critical. A fraction of a millimetre shortfall in margin width may render a barcode unscannable or may mean that only some scanners can scan it.

Thermal printers

Thermal printers can not print barcodes at precisely 80% because the size of the pixels in their print heads. EAN/UPC symbols printed on thermal printers may be printed slightly below 80% to achieve a better pixel size/bar width alignment. Bar height and light margin requirements must not go below 80% requirements in any case.

Appendix 3 **Barcodes on traded units**

Traded units are sometimes called trade items not crossing a retail point-of-sale. They may be known as outers, cases, cartons or shippers. These units may cross a wholesale point-of-sale, and may also be scanned in automated goods handling systems. They are the items handled by manufacturers, distributors, wholesalers, and retailers at inwards goods and they usually contain a predefined number of consumer units.

These items can be barcoded with retail barcodes, ITF-14 or GS1-128 symbols depending on the type of outer case packaging material being used and the type of information required by trading partners.

Some products, such as washing machines, furniture or large multipacks of canned drinks, are both traded units and consumer units. If this is the case the item number is the same for both uses. A retail barcode symbol is required for the retail point-of-sale.

GS1 DataBar and GS1 DataMatrix are intended for special uses. See Appendix 7, page 51 and Appendix 9, page 56. They are not intended for general use on traded units.

Using retail barcodes on a traded unit

If a retail barcode is printed on the packaging of a traded unit:

- The barcode must have a magnification of at least 150%, so that the width of the narrowest bars is at least 0.495 mm, up to a maximum of 200%, when the narrowest bars would be 0.660mm

- GS1 specifications recommend four barcodes but will accept a lesser number down to one. The Australasian grocery trade minimum is two and Woolworths require six, one on each surface of the unit

- Where only two barcodes are applied one should be on a short end and the second on the adjacent long right hand side

- It must not be possible to scan any of the barcodes on any of the items inside through or around the outer packaging

- The barcode must have light margins to the left and right, and the use of light margin indicators is strongly recommended as a means of safeguarding these

- The barcode must be horizontal, in picket fence orientation, so that the bars are vertical

- Where possible centre the barcode on the panel but if this is not possible, the barcode including its light margins must be no closer than 19 mm to a vertical edge

- Position the barcode so that the vertical bars fill a horizontal band 32mm to 64mm above the base of the unit. If your printer has trouble positioning the barcode precisely one option is to print it with vertical bars taller than the specified minimum height so that the required band is filled and some extra bar height protrudes above and/or below it

- If you are printing retail barcodes straight on to corrugated board bearer bars around the barcode are not required but they are helpful in improving print quality and their use is recommended

Examples of EAN-13 and UPC-A barcodes printed at a magnification of 150% are shown:

EAN-13

UPC-A

Using ITF-14 barcodes

Users will generally use ITF-14 symbols when barcodes are being printed directly on to corrugated outer cases.

If you must provide extra variable information such as expiry dates or batch numbers, you will have to use GS1-128 barcodes that are explained later.

Examples of an ITF-14 symbol printed at its nominal size (a magnification of 100% which is equivalent to an X-dimension of 1.016mm) and at a reduced size of 62.5% are shown on the next page. As with the retail barcodes the aim is to print a scannable barcode within the specified size range. For ITF-14 symbols the range of sizes is from 50% to 100%, which is equivalent to an X-dimension range of 0.495mm to 1.016mm.

In the following illustrations the 100% and 62.5% barcodes illustrate the format required when printing plates are used. The 50% barcode illustrates the format that may be used with other print methods and includes optional light margin indicators.

ITF-14 barcode at 100% magnification

0 5 0 1 2 3 4 5 6 7 8 9 0 0
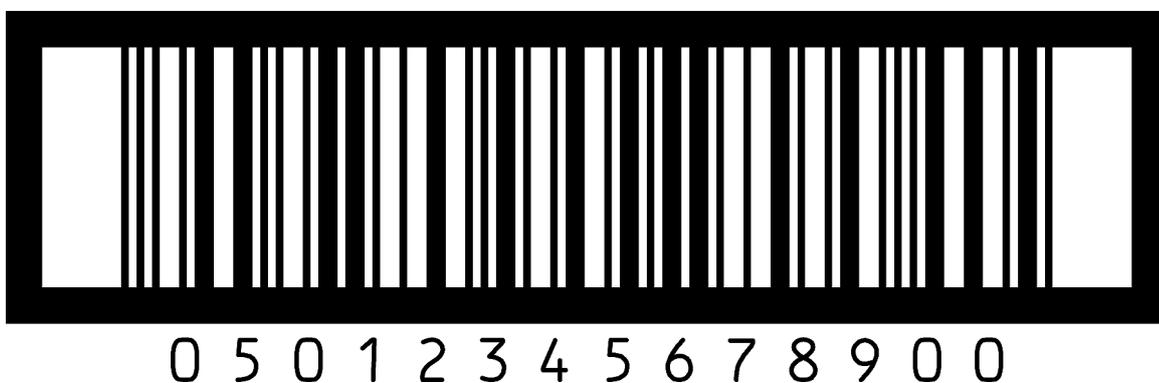
ITF-14 barcode at 62.5% magnification

05012345678900
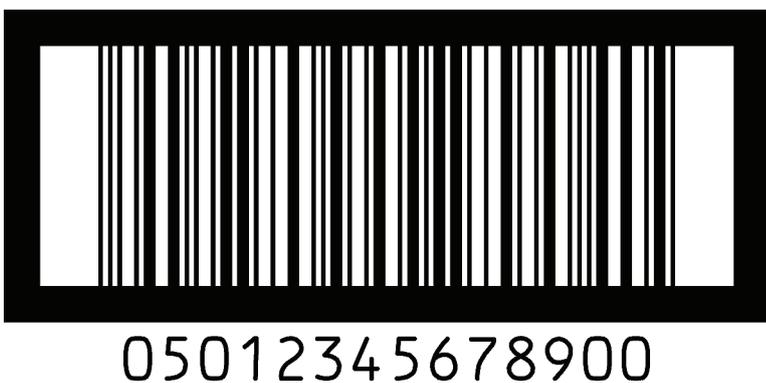
ITF-14 barcode at 50% magnification

〈050 12345 67890 0 〉

Main requirements

- When printing directly on to corrugated cases use 100% sized symbols which have an X-dimension of 1.016mm. Using this size addresses the size requirements of all supply chain participants

- GS1 specifications recommend four barcodes, one on each side, but will accept a lesser number down to one. The Australasian grocery trade minimum is two and Woolworths require six, one on each surface of the unit

- Where only two barcodes are applied one should be on a short end and the second on the adjacent long right hand side

- The bars should be at least 32mm tall regardless of magnification, measured from top to bottom of vertical bars and not including the thickness of the bearer bars

- Position the barcode so that the vertical bars (not including the bearer bars) fill a horizontal band 32mm to 64mm above the base of the unit. If your printer has trouble positioning the barcode precisely one option is to print it with vertical bars taller than 32mm +/- 3mm above and/or below it

- Clear light margins should be provided on both sides of the symbol

- The barcodes on the consumer units inside the outer case must not be scannable through the outer packaging

- The barcodes must be horizontal, in picket fence orientation, so that the bars are vertical

- The barcodes including their light margins must be no closer than 19mm to a vertical edge

- The minimum acceptable size for an ITF-14 barcode printed directly on to paper is 50% but when printing directly on to Kraft paper or corrugated board GS1 specifies a minimum of 62.5%, the Australasian grocery trade requires 90% and Woolworths requires 100%

- The recommended bar width ratio for wide to narrow bars is 2.5 to 1. The allowable range is 2.25 - 3.0:1

- Use ITF-14 symbols smaller than 62.5% only when printing on to labels, or directly on to high quality substrates; samples will need to be checked to ensure that these symbols are scannable

Bearer bars

The heavy box around the ITF-14 symbol is called the bearer bar and it must always be included when printing by any method that involves using plates. Bearer bars maximise the area of the plate and improve the registration of the print. They may be printed around any type of barcode to assist in maintaining quality.

If the ITF-14 symbol is printed using on demand label printing equipment it is only necessary to print the top and bottom bearer bars and these should be at least twice as wide as the narrow bars in the barcode.

Bearer bars also prevent any mis-scanning of the ITF-14 symbols, and help prevent the top and bottom of the bars from splaying apart when using flexographic printing plates. When these barcodes are printed on demand the bearer bar still prevents mis-scans and may also provide a visible check that all the print head elements are working.

Light margin indicators

Light margin indicators are not required by the GS1 specifications, but they can be used to indicate the presence of the light margins or quiet zones. Users of ITF-14 symbols must be confident that adequate light margins are being provided.

It is also important to check that any final wrapping or treatment of the item does not obscure the barcodes.

H Gauges

These are used by the printer to aid visual inspection of the plate pressure during printing. They are recommended for plate printing of ITF-14 barcodes. They need not be used for thermal printing of ITF-14 barcodes or where the printer has other means of monitoring the printing quality. When used the H gauge should be placed outside the light margins specified, but inside the vertical lines of the box surrounding the ITF code.

Please consult barcode software suppliers for possible updates.

GS1-128 is not the same as Code 128

Using GS1-128 barcodes

These barcodes are now referred to as GS1-128 but may be specified as EAN-128, UCC/EAN-128 or UCC-128 in older literature and software as the current name was introduced in 2005. GS1-128 enables companies to provide additional information about a product alongside the GTIN for the product itself. These barcodes cannot be scanned at the retail point of sale so they are restricted to use on traded units or pallets.

GS1-128 is recommended when it is necessary to scan:

- Use by and best before dates
- Measurements for variable measure products
- Batch and serial numbers
- Any other variable information about a product

Application identifiers are significant sets of digits that are used in GS1-128 number formats and barcodes to signal to the processing software what the associated data represents. For example (17) 271103 means a use by date of 3 November 2027. In this case (17) is the application identifier. Dates are expressed in the format YYMMDD.

See Appendix 6, page 47 for information on GS1-128 barcodes and application identifiers. The types of data must be specified by the application identifiers that appear in parentheses before each data field. Remember that the parentheses are not data and must not be encoded in the symbol. The parentheses are only shown around the human readable numbers below each barcode.

The size of the GS1-128 barcode depends on the amount of information it includes therefore:

- Make sure no barcode, including its light margins, is longer than 165mm
- If the barcode would be too long, use two or more barcodes each above the other to show the information

Main requirements

- GS1 specifications require at least one GS1-128 barcoded label on a unit but the Australasian grocery trade including Woolworths require two
- When printing on labels, the minimum allowable size is 50%, which means the narrowest bars and spaces have a width of 0.5mm
- Printing GS1-128 on corrugated board is very difficult and best avoided but if it must be done print only at 100% with an X-dimension of 1.016mm. The minimum bar height is 32mm
- If you are printing GS1-128 straight on to corrugated board bearer bars are not required but they would be helpful in improving print quality and their use is recommended in this situation.
  Note: GS1 does not recommend printing GS1-128 straight on to corrugated board
- Position the barcode so that the vertical bars are 32mm +/- 3mm above the base of the unit. There is no objection to over height bars.

- The barcodes must be horizontal, in picket fence orientation, so that the bars are vertical
- The barcodes including their light margins must be no closer than 19mm to a vertical edge. The barcodes on the consumer units inside the outer case must not be scannable through the outer packaging.

The barcodes on the consumer units inside the outer case must not be scannable through the outer packaging. For further information

Bearer bars

These are not required by the GS1 specifications, but users will find them a helpful addition. When GS1-128 barcodes are printed on demand in picket fence orientation any missing print head elements will show up as white gaps in the bearer bars at the top and bottom of the symbol. The use of bearer bars will help ensure accurate production of these symbols.

Light margin indicators

These are not required by the GS1 specifications, but they can be used to ensure that adequate light margins or quiet zones are being provided. Users must be confident that sufficient light margins are provided at each side of the symbol. The illustration below provides an example of a suitable format for these.

Products with a shelf life of up to 90 days

In Australia and New Zealand most retailers expect use-by or best before dates to be barcoded on products whose shelf life is less than 90 days.

An example of a barcode for a short life product is shown below. The AI(01) defines the GTIN for the product while the AI(15) defines the best before date in the format YYMMDD. If a use by date is required, the AI(17) is used.

The data in this barcode provides the information that the GTIN is 25012345678904 and that the product's best before date is 5 November 2024.

The GS1-128 barcode shown has light margins to the left and right that are also indicated by the optional light margin indicators. Light margins are 10 times the X-dimension of the barcode.

For further information about on demand printing, see

< (01)25012345678904(15)241105 >

Variable measure products

When traded units contain variable weight items (items that do not have a predefined weight), then the net weight of the contents must be shown in a GS1-128 barcode. Other variable measures such as length, area and volume can be shown using different application identifiers, but weight is the most common variable measure. For further details about the other application identifiers, see choosing the correct application identifiers, page 49, or GS1 specifications available through GS1 New Zealand's website.

- Use the AI(3102) to give the net weight in kilograms to two decimal places. Other AIs can be used to give weight to a different number of decimal places
- The GTIN must be a 14-digit number beginning with 9.

The data in this barcode provides the information that the GTIN is 95012345678903, that the product's net weight is 12.75 kilograms, and that the expiry date is 3 November 2024.

< (01) 95012345678903 (3102) 001275 (17) 241103 >

Software

Some software packages for barcode production may not have been updated to reflect changes to GS1 specifications.

Please consult software suppliers for possible updates.

Appendix 4 Barcode dimensions

Nominal dimensions of EAN/UPC and ITF-14 barcodes. These illustrations are not to scale. All measurements are in millimetres.

EAN-13

3.63   Light margins   2.31
22.85   25.91
5 012345 678900
31.35
37.29

UPC-A

2.97   Light margins   2.97
23.85   25.91
6 14141 00086 9
31.35
37.29

UPC-E

2.97   Light margins   2.31
22.85   25.91
0 012345   7
16.83
22.11

EAN-8

2.31   Light margins   2.31
18.23   21.31
5012 3452
22.11
26.73

ITF-14

Light margin   Light margin
122.4
10.9   10.9
4.8
31.8
*
0 5 0 1 2 3 4 5 6 7 8 9 0 0
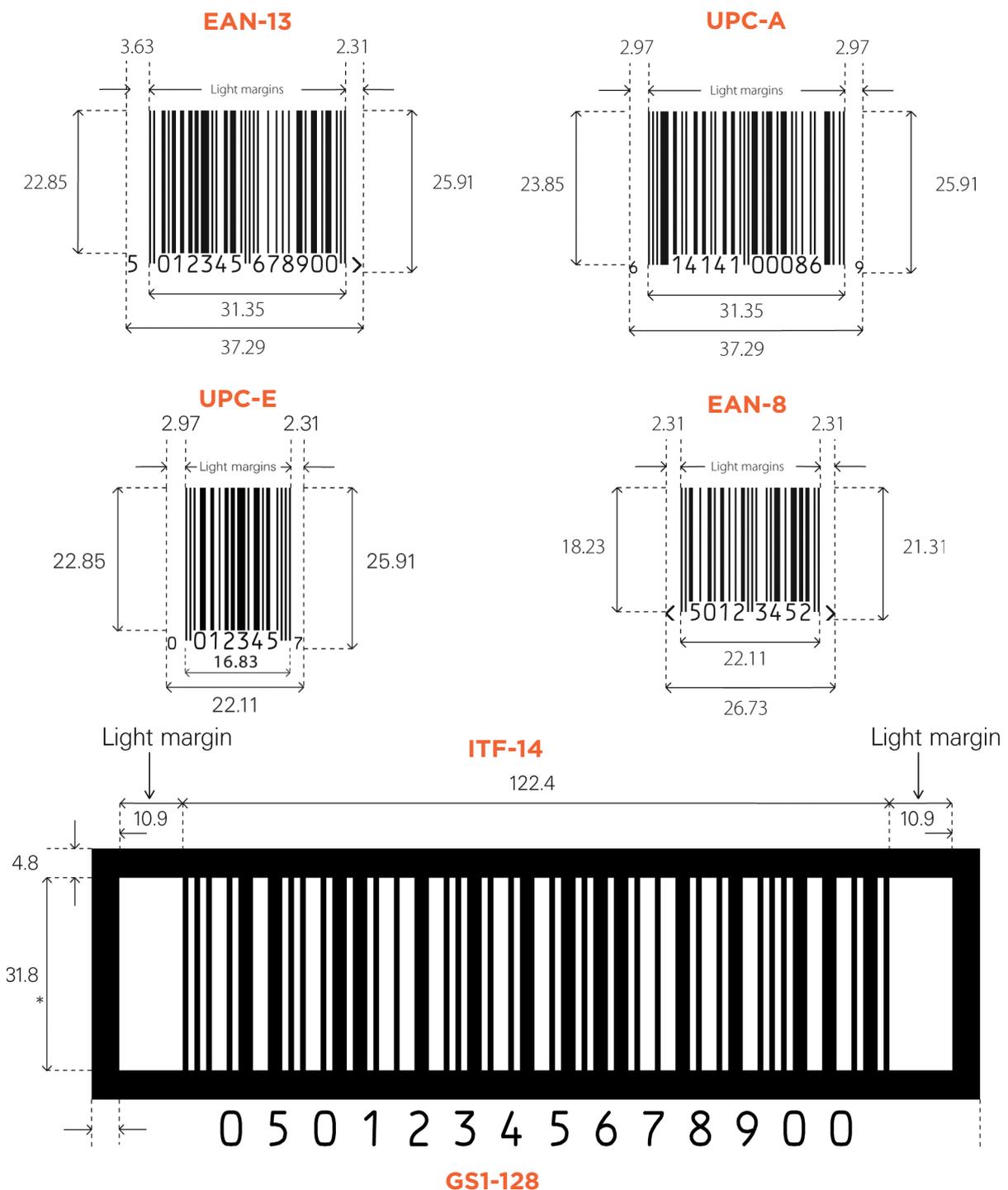
GS1-128

The overall dimensions of a GS1-128 barcode will vary according to how much data is encoded, but when printed at 100% the module width of a GS1-128 symbol is 1mm and bar height is 32mm*. See method of calculating length on Appendix 6, page 48.

The light margin dimensions shown above are the minimum for nominal sized symbols and in practice extra space must be provided to allow for printing variations. These light margins also change in proportion with any increase or decrease in the magnification of these symbols. Light margins should generally be 10 times the X-dimension but note that EAN-8 and EAN-13 have wider left light margins than right.

* Minimum. Does not vary with size

Appendix 4a

Dimensions of EAN-13 and EAN-8

	X-Dimension (mm)	Dimensions of symbols (mm)					
		EAN-13			EAN-8		
		Width (1)	Width (2)	Height (see notes)	Widths (1)	Width (2)	Height (see notes)
080	0.26	29.83	25.08	18.28	21.38	17.68	14.58
085	0.28	31.70	26.69	19.42	22.72	18.82	15.50
090	0.30	33.56	28.21	20.57	24.06	19.89	16.41
095	0.31	35.43	29.73	21.71	25.39	20.97	17.32
100	0.33	37.29	31.35	22.85	26.73	22.11	18.23
105	0.35	39.15	32.87	23.99	28.07	23.23	19.14
110	0.36	41.02	34.48	25.14	29.40	24.32	20.05
115	0.38	42.88	36.05	26.28	30.74	25.42	20.96
120	0.40	44.75	37.62	27.42	32.08	26.54	21.88
125	0.41	46.61	39.18	28.56	33.41	27.63	22.79
130	0.43	48.48	40.75	29.71	34.75	28.75	23.70
135	0.45	50.34	42.32	30.85	36.09	29.85	24.61
140	0.46	52.21	43.89	31.99	37.42	30.96	25.52
145	0.48	54.07	45.46	33.13	38.76	32.06	26.43
150	0.50	55.94	47.02	34.28	40.10	33.18	27.32
155	0.51	57.80	48.59	35.42	41.43	34.27	28.26
160	0.53	59.66	50.16	36.56	42.77	35.37	29.17
165	0.54	61.53	51.73	37.70	44.10	36.48	30.08
170	0.56	63.39	53.29	38.85	45.44	37.58	30.99
175	0.58	65.26	54.87	39.99	46.78	38.7	31.90
180	0.59	67.12	56.43	41.13	48.11	39.79	32.81
185	0.61	68.99	58.01	42.27	49.45	40.91	33.73
190	0.63	70.85	59.56	43.42	50.79	42.01	34.64
195	0.64	72.72	61.14	44.56	52.12	43.12	35.55
200	0.66	74.58	62.70	45.70	53.46	44.22	36.46

Notes

1. Width (1) includes light margins and represents the total horizontal space the symbol and background should occupy.

2. Width (2) excludes light margins and represents the horizontal measurement between the first and
 last bars.

3. See Appendix 1b for light margin widths.

4. Height is measured from the top to the bottom of the bars excluding the six longer bars and the printed numbers. Note that the specified height is a minimum. It may be exceeded.

5. Where an EAN-13 is printed on a traded unit that is also likely to be retailed the symbol must be printed at 200% unless the size and shape of the unit compel use of a smaller size in which case size may be reduced to 150% but not below.

6. Thermal-printed barcodes may in some cases be printed below 80%. Contact GS1 New Zealand or an accredited supplier for details.

7. UPC users, see the notes beneath the table of light margin widths on the next page.

Appendix 4b EAN-13 and EAN-8 Light Margins

Magnification factor %	EAN-13		EAN-8	
	Left mm	Right mm	Left mm	Right mm
80	2.90	1.85	1.85	1.85
85	3.08	1.96	1.96	1.96
90	3.27	2.08	2.08	2.08
95	3.45	2.19	2.19	2.19
100	3.63	2.31	2.31	2.31
105	3.81	2.42	2.42	2.42
110	3.99	2.54	2.54	2.54
115	4.17	2.66	2.66	2.66
120	4.36	2.77	2.77	2.77
125	4.54	2.89	2.89	2.89
130	4.72	3.00	3.00	3.00
135	4.90	3.12	3.12	3.12
140	5.08	3.23	3.23	3.23
145	5.26	3.35	3.35	3.35
150	5.44	3.46	3.46	3.46
155	5.63	3.58	3.58	3.58
160	5.81	3.70	3.70	3.70
165	5.99	3.81	3.81	3.81
170	6.17	3.93	3.93	3.93
175	6.35	4.04	4.04	4.04
180	6.53	4.16	4.16	4.16
185	6.71	4.27	4.27	4.27
190	6.90	4.39	4.39	4.39
195	7.08	4.50	4.50	4.50
200	7.26	4.62	4.62	4.62

UPC-A and UPC-E

UPC-A dimensions are the same as those for EAN13 symbols of the same magnification except that the light margins are of equal width. The margin widths stated for EAN-13 should be added and halved for use with UPC-A.

UPC-E symbols occupy the same total width as the corresponding EAN-8 barcodes but the light margins are not of equal width and the distance between the first and last printed bars is less. Bar height for UPC-E symbols is that of a UPC-A barcode of the same magnification.

Appendix 5 Printing techniques

General

Virtually all consumer units (products that will be sold at a retail point-of-sale) and very many traded units (the outer cases for the consumer units) will be sold in packaging that is printed with the appropriate barcode. Some items will use barcoded labels and advice about using these is provided in the following section of this Appendix.

The image of the barcode that is included in the artwork will need to be adjusted to take account of the spread of ink. This is necessary because direct contact printed bars in barcodes print wider than the actual width of bars on the printing plate. The difference between the width of the bar as it is printed and the specified width on the printing plate is called print gain.

Each bar on the printing plate needs to be reduced in width by the average print gain and this is known as bar width reduction. All widths of bar have the same bar width reduction so that the spaces on the printing plate will be wider than they will be when they are printed. Printers will be able to manage these issues.

Different printing techniques have different tolerances for printing accuracy and different print gains, so it is important to check what these are before choosing a particular size of barcode symbol. The choice of substrate used in the printing process will also affect the size of the barcode that can be accurately printed.

If possible, when using flexographic printing, the bars should run parallel to the press web direction. If the bars are required to be perpendicular to the press direction, try to avoid distorting the symbol for the plate roll circumference. This lack of distortion will alter the overall width of the symbol, but will provide dimensional integrity.

In printing on corrugated board higher print quality will be achieved when the bars of the barcode lie in the same direction as the corrugations. Regardless of bar orientation, bearer bars will always improve the quality of any barcodes printed on corrugated board. Their use is mandatory with ITF-14 but highly recommended in all cases involving corrugated board.

When using either silkscreen or rotogravure printing processes, the symbol should be aligned parallel to the cell structure on the screen or gravure plate cylinder to provide the smoothest bar edge possible.

Remember to test printed barcodes with a verifier that conforms to ISO/IEC 15426-1. Ordinary scanners cannot perform a valid test of barcode quality.

> Bearer bars will always improve the quality of barcodes printed on corrugated board.

Printing on demand

Printing barcodes on demand is necessary when including variable information, such as expiry dates in GS1-128 barcodes for traded units. Some users will want to print barcoded labels on demand for some consumer units, especially when these items are not contained in pre-printed packaging. On demand printing techniques include direct thermal, thermal transfer, laser, ion deposition and ink jet. Whether printing any type of barcode the same principles apply.

Check that your label software is compatible with the printer hardware you are planning to use, and that the printer resolution is adequate for the barcodes you are printing. In general, this means that your printer must have a resolution of at least 8 dots per mm (approximately 200dpi) as it has to use a whole number of dots to make up the width of the narrowest bars required.

An 8 dots per mm printer will be able to print barcodes whose X-dimensions are 0.25mm, 0.375mm, and 0.50mm. A 12 dpmm printer (approximately 30dpi) will print bars with X-dimensions of 0.25mm, 0.333mm, 0.416mm, 0.50mm and so on.

All on demand printers, whether they are direct thermal, thermal transfer, dot matrix, ink jet or laser, will print better barcodes with well defined edges if they are printing the barcodes in picket fence orientation. This means that the bars go in the same direction as the substrate when it passes through the printer.

Printing in picket fence orientation means the barcode width can be no wider than the print head.

If it is necessary to print a barcode that would be wider than the print head, then it must be printed in ladder orientation. This means that any failure in the print head elements will cause white lines to appear across the barcode. These faults in effect reduce the height of the barcode and make it difficult to scan.

Matching the label stock with the technique being used is also important. Poor quality paper may create dust, which can cause the print heads to burn out more quickly. It is necessary to match thermal transfer ribbons to the equipment being used, and ensure the correct pressures are used with the print heads. The incorrect choice of ribbon and paper may be workable, but the machinery is likely to require much higher maintenance costs and require much more frequent servicing.

It is highly recommended to use validated combinations of ribbons and labels, and to use verification equipment to check the print quality. Regular cleaning and maintenance of your thermal printer is very important for barcode quality. Clean print heads gently with a good quality solvent and avoid scratching them with any hard materials.

Direct thermal printing may be appropriate for some products, and the correct label stock must be sourced. Remember that these labels remain heat sensitive and may be inappropriate if goods are kept in direct sunlight or if the labels are heated in any subsequent process. The whole label may turn black if heated.

Remember to test printed barcodes with a verifier that conforms to ISO/IEC 15426-1. Ordinary scanners cannot perform a valid test of barcode quality.

Appendix 6 Printing GS1-128 barcodes

GS1-128 barcodes are nearly always printed on demand using thermal or ink jet printers, so the equipment operator needs to be aware of the requirements.
Note that GS1-128 is not the same as a Code 128.

Function 1

GS1-128 symbols are a subset of Code 128 and they require a special symbol character (a pattern of three bars and three spaces) called Function 1 to be used as part of the start pattern. If the Function 1 character is not correctly included as part of the start pattern the symbol will not work, because the decoding software will not be triggered to recognise and correctly interpret the application identifiers.

Choosing the correct character set

There is a choice of character sets to help users minimise the space taken up by these barcodes. Use character set C to print pairs of digits using one symbol character (a pattern of three bars and three spaces) rather than two symbol characters whenever possible. If single letters or numbers are required use character sets B or A.

Fixed length and variable length fields

GS1-128 barcodes can represent different sets of numbers e.g. GTIN and packing date and weight in one barcode symbol. This joining together of information in one barcode symbol is called concatenation. When these number strings are fixed in length, such as those for the GTIN and expiry dates, they simply follow one another.

When variable length fields are used, they should follow the fixed length ones with Function 1 character inserted at the end of each string to separate it from the next in the manner of a comma. This is not required after the final string as the symbol stop character will indicate that the barcode has ended. The principle to observe in concatenating GS1-128 is: GTIN; fixed length fields; variable length fields. This minimises barcode length and makes the processing simpler for the software that decodes the barcode.

Choosing the correct size

GS1-128 barcodes can vary in size according to how much data is in them, and how well they can be printed. The maximum width for the X-dimension (the width of the narrowest bars and spaces) is 1.016mm and the minimum X-dimension is 0.495mm when these barcodes are used on trade items not crossing a retail point-of-sale. (This range of X-dimensions is equivalent to a magnification range of 100% to 50%).

Users must choose an X-dimension that can be reproduced by their on-demand printing equipment. The X-dimension must be a multiple of the size of the smallest line that can be printed, and if an 8 dpmm (200dpi) printer is used, the X-dimensions can be 0.50mm, 0.625mm, 0.75mm, 0.875mm and 1.00mm.

Enlarged section of the first part of a GS1-128 barcode showing the Function 1 character in blue.

If users are using labels, an X-dimension of 0.50mm may be acceptable, provided the printed barcodes, when verified, meet the minimum grade required. If users are printing these GS1-128 barcodes directly on to corrugated cartons an X-dimension of 1.00mm is recommended, but verifiers must still be used to check that the barcodes meet the minimum grade required. More information about verification may be found in
Note: Printing GS1-128 barcodes directly on corrugated cartons is NOT recommended

Height of bars

Whichever X-dimension is chosen, the height of the bars should be at least 32mm.

Keeping adequate light margins

The light margins on each side of a symbol which has an X-dimension of 1mm are 10mm. The light margin is always equal to 10 times the X-dimension, but when the X-dimension is 0.50mm it is recommended that the light margins are at least 6.5mm on each side.

When are parenthese required around the application identifiers?

Parentheses are used around each application identifier (AI) when the data is printed below the barcode. This makes it easier for people to read the AI and the data it defines. The parentheses are not encoded in the GS1-128 barcode itself.

Determining the length of a GS1-128 barcode

GS1-128 barcodes will vary in length according to how much information they contain, so it is important to check that the intended length of the barcode and light margins is no longer than 165mm, the maximum allowable width, including light margins. Each symbol character (except the stop character) has a width of 11mm if an X-dimension of 1mm is chosen, and each symbol must include four symbol characters to begin and complete the barcode.

For example, how long will a GS1-128 barcode be that includes a GTIN and an expiry date? The data required in the barcode is all numeric so character set C will be chosen. Character set C is one of three sets of barcode characters available within GS1-128. It contains single barcode characters that represent any 2-digit combination 00-99 so when even numbers of digits are involved it is always used to conserve label space.

The data required in the barcode will be as follows, remembering that the parentheses around the human readable AIs are not included in the barcode:

01050123456789015010211

The formula for calculating the minimum symbol length including quiet zones is:

$$L = (11N + 66)(X)$$

Where:
L = the minimum symbol length (in millimetres)
X = the narrow bar width
N = the number of symbol characters needed in the barcode.
In code set C, two numeric digits are encoded in one symbol character

The start character and FNC1, stop character, the symbol check character, and the quiet zones are accounted for in the constant value "66",

Therefore the length of the barcode in our example can be calculated like this:

11 x 12 (24 digits encoded in Code Set C will require 12 barcode characters) = 132

Plus 66 = 198

X 1 (at 100% magnification the x-dimension will be 1mm)

Answer: our barcode will be 198mm wide – too wide. The maximum allowable width is 165mm. We can reduce the x-Dimension to decide the magnification we want to use.

0.5mm x-dimension (50%) will give us half the width – 99mm

To calculate the width of an GS1-128 barcode use this method to calculate the width required at 100% magnification and then divide your answer to find the X-dimension usable within the available space. Remember that the minimum allowable magnification is 50%, representing an X-dimension of 0.5mm.

Choosing the correct application identifiers

When providing extra information on a traded unit, most users will encode the GTIN for the product with information such as an expiry date. The GTIN on the item must be specified by the AI(01), and the extra information defined using the AIs as explained in the GS1 specifications. The most commonly used AIs and their field lengths are given below.

When labelling pallets, the GS1 logistics label must be used. All the data shown on the label must refer to the contents of the whole pallet. The SSCC is the only compulsory element and will be the only reference used on pallets of mixed product.

For pallets with uniform contents, any of the AIs listed below can be used. Please remember that you cannot use AIs (01) and (02) together. AI(01) should only be used when the pallet is also a traded unit, i.e. it is ordered and invoiced as a single item. In all other cases, use the AIs (02) and (37) to describe the contents of the pallet.

AI	Description	AI	Data
00	Serial Shipping Container Code – SSCC	n2	n18
01	Identification number (GTIN) of a traded item	n2	n14
02	Identification of traded items contained in a logistic unit	n2	n14
10	Batch or Lot number	n2	an...20
11	Production date (YYMMDD)	n2	n6
12	Due date (YYMMDD)	n2	n6
13	Packaging date (YYMMDD)	n2	n6
15	Best-before date (YYMMDD)	n2	n6
17	Use-by date (Safety) (YYMMDD)	n2	n6
21	Serial number	n2	an..20
310n	Net weight, kilograms	n4	n6
320n	Net weight, pounds	n4	n6
37	Count of items contained in a logistics unit	n2	n..8
400	Customer's purchase order number	n3	an...30
401	Consignment number	n3	an..30
402	Shipment identification number	n3	n17
410	Ship to (deliver to) GS1 Global Location Number	n3	n13
411	Bill to (invoice to) GS1 Global Location Number	n3	n13
412	Purchase from GS1 Global Location Number	n3	n13
414	Identification of a Physical Location, GS1 Global Location Number	n3	n13
422	Country of origin of a trade item	n3	n3
8003	Global returnable asset identification (GRAI)	n4	n14+an...16
8007	International Bank Account Number	n4	an..30
8008	Date & time of production	n4	n8+n.4
90	Information mutually agreed between trading partners	n2	an...30

n: numeric characters (number)

an: alphabetical or numeric characters (number)

Dotted line preceding number indicates variable length up to maximum shown

The combination 'an' is shown as 'X' in some technical literature.

This is not an exhaustive list of all the application identifiers that can be used on traded units or on pallets. Please consult the GS1 specifications to find a complete listing of all the AIs.

Appendix 7 GS1 DataBar Symbology

The GS1 DataBar symbology, is a suite of seven barcode symbol variants capable of containing GTINs with or without supplementary information, usually in less space than other GS1 symbologies. The effect of using GS1 DataBar is to encode information in less space than is generally possible with other GS1 symbologies. As well, data such as batch numbers and use by dates that can currently be encoded only in larger barcodes used on pallets and cartons can now be encoded in barcodes that can be scanned at retail point-of-sale.

Four of the variants are useable at the point-of-sale (POS) once the scanning systems are enabled. The other three are intended for use in specific environments such as laboratories, hospitals and manufacturing facilities where small dense barcode symbols are required. DataBar barcodes cannot be scanned with the omnidirectional scanners that are typically used in retail environments.

Note, this appendix is for users of GS1 DataBar in retail environments and in the supply chains of goods bound for retail. Separate specifications exist in other sectors, notably health. DataBar implementation has been uneven so far and many retailers can not scan it yet. Intending users should confirm its acceptability with their trading partners. This appendix is an introduction and overview only and may not be definitive in particular applications.

For information on GS1 DataBar specifications for other sectors please contact GS1.

Examples of GS1 DataBar symbols

GS1 DataBar
Omnidirectional

(01)09501101420021

GS1 DataBar Stacked
Omnidirectional

(01)09412345670038

The other two POS-compatible GS1 DataBar barcode variants, GS1 DataBar Expanded and GS1 DataBar Expanded Stacked are similar in appearance but may be larger depending on the amount of data encoded. In any case barcode size will vary with the size choices made by the user.

Obtaining a GTIN for use with GS1 DataBar

DataBar barcodes need 14-digit numbers encoded. This is because of technical issues about their structure. Simply obtain a GTIN-13 and use it with a leading zero to create a number 14 digits long. For example 94123456700038 becomes 094123456700038.

Generally the responsibility for GTIN allocation remains the same in all situations, and that is the brand owner. However where DataBar barcodes are used on loose fruit and vegetables, the following rules apply **in the Australian and New Zealand markets only.**

- Where the fruit will go to market branded, the brand owner is responsible for allocating the GTIN
- Where the fruit will go to market with no brand, the packhouse is responsible for

allocating the GTIN, unless the customer has specified a GTIN to use
- A separate GTIN is required for each variety going through each packhouse, eg. two varieties that could go through any of three packhouses = 6 GTINs

A grower who supplies fruit to a country other than New Zealand or Australia may use any one of the GTINs used in Australia and New Zealand provided any PLU printed on the label is usable in the other target market. If it is not, then a new separate GTIN is required.

GS1 DataBar encodes fourteen-digit numbers only. Users must use GTIN-13 with a filler zero (leading zero). This is achieved by using the GTIN obtained from MyGS1 with the leading zero retained. GTIN-13s made up by converting ISBNs and ISSNs may not be used in GS1 DataBar symbols. GTIN-14s may not be used in GS1 DataBar symbols.

Where the symbol contains additional data AIs must be used in the usual manner . This applies when GS1 DataBar Expanded or GS1 DataBar Expanded Stacked is used.

Technical information

Size

The X-Dimensions useable in GS1 DataBar are the same as those for EAN/UPC symbols, with the exception of GS1 DataBar Stacked Omnidirectional symbols used on the Price Lookup (PLU) labels used on some fresh produce. These may be printed at X-Dimensions down to 0.2032mm which will produce a symbol 10mm wide[2].

Height

Truncation is not permitted unless intending to use GS1 DataBar in its 'truncated' format, which is not permissible in retail. (POS-compatible symbols indicated with *)

Symbol Height	
GS1 DataBar Omnidirectional*	33X to...(no maximum)
GS1 DataBar Truncated	13X to 33X
GS1 DataBar Stacked	13X (5X + 1X + 7X)...(no maximum)
GS1 DataBar Stacked Omnidirectional*	69X (33X + 3X + 33X) 2 rows max., no max total height.
GS1 DataBar Limited	10X ......(no maximum)
GS1 DataBar Expanded*	34X.......(no maximum)
GS1 DataBar Expanded Stacked*	71X (34X + 3X + 34X) per 2 rows, to max 11 rows (404X)[3]
Data Encoded	
GS1 DataBar Omnidirectional (both versions, and GS1 DataBar Limited)	AI(01) plus GTIN-14 (i.e. 16n)
GS1 DataBar Expanded	74n or 41a

Separator Pattern

When a symbol is stacked there should be a 'Separator Pattern' between the rows. This serves a purpose similar to the horizontal bearer bars above and below the data bars in ITF-14 symbols and prevents scanners scanning two lines at once and being unable to process the data. It is a precise pattern of light and dark squares that are printed in positive and negative at different points along its length. The Separator Pattern in the case of the symbols useable at retail is always 3X in height.

Human readable

Human readable data must be printed beneath symbols. When using GS1 DataBar the AI(01) and the GTIN should be shown. The allowable exception is in fresh produce when label size precludes this, but in that case the price look up number (PLU) should appear somewhere on the label unless the customer specifies otherwise.

Colour coding PLU labels

Some customers may require certain colours to differentiate labels on different varieties. This is not a GS1 specification and is between the parties.

Light margins (Quiet zones)

Light margins are not required with GS1 DataBar. The symbols contain 'finder patterns' which alert the software to the presence of the data carrying characters. Users must ensure that a light bar is on the outside of the symbol. Graphics or other colours must not contact any printed bar.

GS1 DataBar on non consumer units

GS1 DataBar is not intended for general use on non consumer units although there is a growing range of special uses on logistics labels. Talk with GS1 if a customer requests this.

Verification

The required minimum grade is 1.5./06/660. Provided the verifier is capable of verifying GS1 DataBar symbols there will be no difference in the report that is produced. The same parameters are reported and all the same interpretations apply. The Separator Pattern is not tested in the verification test as its quality is not critical to barcode performance. Nevertheless, maintaining print quality in the Separator Pattern is best practice. Note, not all verifiers that are approved for use in verifying the pre-existing range of GS1 barcodes are capable of verifying GS1 DataBar. Intending users should seek advice on suitable verification equipment.

Scanners

All modern scanners, once enabled, are capable of reading GS1 DataBar Omnidirectional and GS1 DataBar Expanded and their stacked variants. However not all scanners currently in use are enabled, so users should not consider implementing GS1 DataBar without the knowledge and consent of their trading partners.

DataBar requires a 14-digit number. It must be a GTIN-13 with a filler zero. GTIN-14 may not be used.

1   UPC users would use GTIN-12 preceded by two zeroes to achieve the same outcome

2   This is a special exception permitted as an interim measure in the fresh produce sector because of the ubiquity of PLU labels and the impossibility of replacing them in the short term.

3   * Need not be even numbers of rows: 2 – 11 permissible

Appendix 8 Symbol show through

When a traded unit is barcoded it must not be possible to read any of the barcodes on the consumer units inside the packaging. If the barcodes can be read, there is a good chance that one of these will be read instead of the correct one on the outside of the case. This problem is called symbol show through.

When show through takes place it makes it very difficult to use an automatic scanning system reliably as the wrong item may be scanned. This means incorrect data capture and the wrong price being charged at the point-of-sale.

This is a particular problem for wholesalers who sell both traded and consumer units to their customers. They need to be able scan all GS1 barcodes at the point-of-sale so are particularly vulnerable to problems when more than one barcode shows on a unit.

This problem also affects grocery and other retailers who sell large multipacks that are also traded units. Care must be taken to avoid packaging consumer units so that their barcodes are visible in their entirety. Recent packaging waste initiatives are encouraging many manufacturers to make more use of shrink wrapping, and using patterned or obscuring film may be considered as a means of making consumer unit barcodes unreadable.

If the consumer units are rectangular in plan it may be possible to ensure that all the barcodes on the individual items face inside the outer case, but this will not be feasible with round products such as cans and bottles. When consumer units are packed on cardboard trays and then shrink wrapped, show through can be avoided by printed the barcodes in ladder orientation and towards the bottom of each consumer unit. This will mean that the edges of the tray will obscure part of the consumer unit's barcodes and make them unscannable.

Appendix 9 GS1 DataMatrix Symbology

Introduction

This appendix addresses some of the technical aspects of the two-dimensional barcode symbology called GS1 DataMatrix. GS1 DataMatrix is a standalone, two-dimensional matrix symbology that is made up of square modules arranged within a perimeter finder pattern. GS1 DataMatrix does not require a linear symbol. It has been used in the public domain since 1994.

This document provides only a brief technical description and overview of the GS1 DataMatrix symbology. A more detailed technical specification can be found in the International Standard ISO/IEC 16022. The GS1 System has adopted GS1 DataMatrix because it can encode GS1 System data structures and offers other technical advantages. Its compact design and the existence of various production methods that accommodate placing the symbology onto various substrates offer certain advantages over other symbologies currently in the GS1 System.

DataMatrix ISO version ECC 200 is the only version that supports GS1 System data structures, including Function 1 Symbol Character. The ECC 200 version of DataMatrix uses Reed-Solomon error correction, and this feature helps correct for partially damaged symbols. In the remainder of this section, the ECC 200 version of DataMatrix is assumed when the symbology is described as GS1 DataMatrix. This version of DataMatrix is similar in stability to ISO versions of current GS1 System symbologies.

Implementation of GS1 DataMatrix shall be done per approved GS1 System application guidelines. For these refer to GS1 for advice specific to your sector and application. Some of the production processes that can be used to produce GS1 DataMatrix Symbols are as follows:

Direct part marking, such as is done by dot peening on items, e.g. automotive, aircraft metal parts, medical instruments, and surgical implants.

Laser or chemically etched parts with low contrast or light marked elements on a dark background (e.g., circuit boards and electronic components, medical instruments, surgical implants)

High speed ink jet printed parts and components where the marked dots cannot form a scannable linear symbol.

Very small items that require a symbology with a square aspect ratio that cannot be marked within the allocated packaging space by existing GS1 DataBar or Composite Symbols

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.

GS1 DataMatrix features and symbol basics

GS1 DataMatrix symbol

This corner is always a white square for ECC 200

"L" shaped finder pattern ⟶
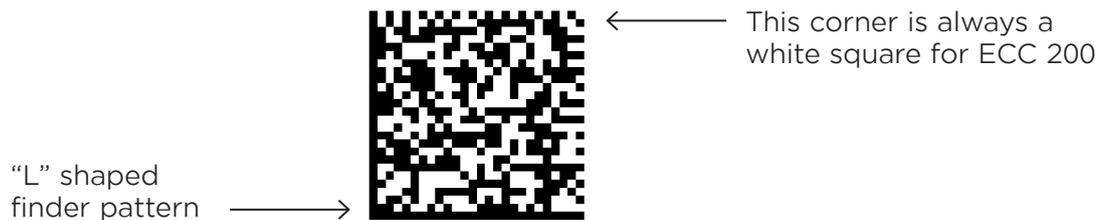
Illustrated above is a GS1 DataMatrix Symbol with 20 rows and 20 columns (including the perimeter finder pattern but not including Quiet Zones).

- 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 recognized from older versions of DataMatrix 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.
- FNC1 for GS1 System compatibility must be encoded at the beginning of the data string and should be used as a group separator. When a FNC1 is used as a group separator, it shall be represented in the transmitted message by the ASCII character <GS> (ASCII value 29).
- Encodable character set:
  - Values 0 - 127 in accordance with ISO/IEC 646 International Reference Version (e.g., all 128 ASCII characters)
  - Values 128 - 255 in accordance with ISO/IEC 8859-1; Latin alphabet No. 1. These are referred to as extended ASCII.
  - The GS1 System requires that only the subset of ISO/IEC 646 International Reference Version defined in these GS1 General Specifications be used for Application Identifier (AI) Element Strings.
- Data characters per symbol (for the maximum symbol size):
  - Alphanumeric data: up to 2,335 characters
  - Eight-bit byte data: 1,556 characters
  - Numeric data: 3,116 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

GS1 DataMatrix Symbology

The technical description of GS1 DataMatrix contained herein 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 illustrations have been magnified to show detail.

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 illustration below.

Rectangular and Square GS1 DataMatrix Symbols
(Specific applications are not used in the data encoding. Both symbols contain the same data.)
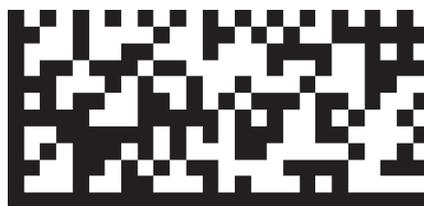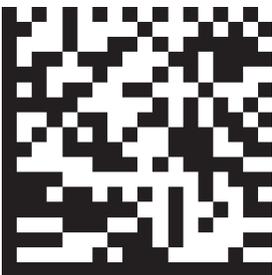
GS1 DataMatrix Symbol Sizes

GS1 DataMatrix Symbology has multiple sizes to match various data content. 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 encoding in the symbol." Codewords are typically eight bits of data. FNC1, two numerics, and one alpha all take up one codeword each.
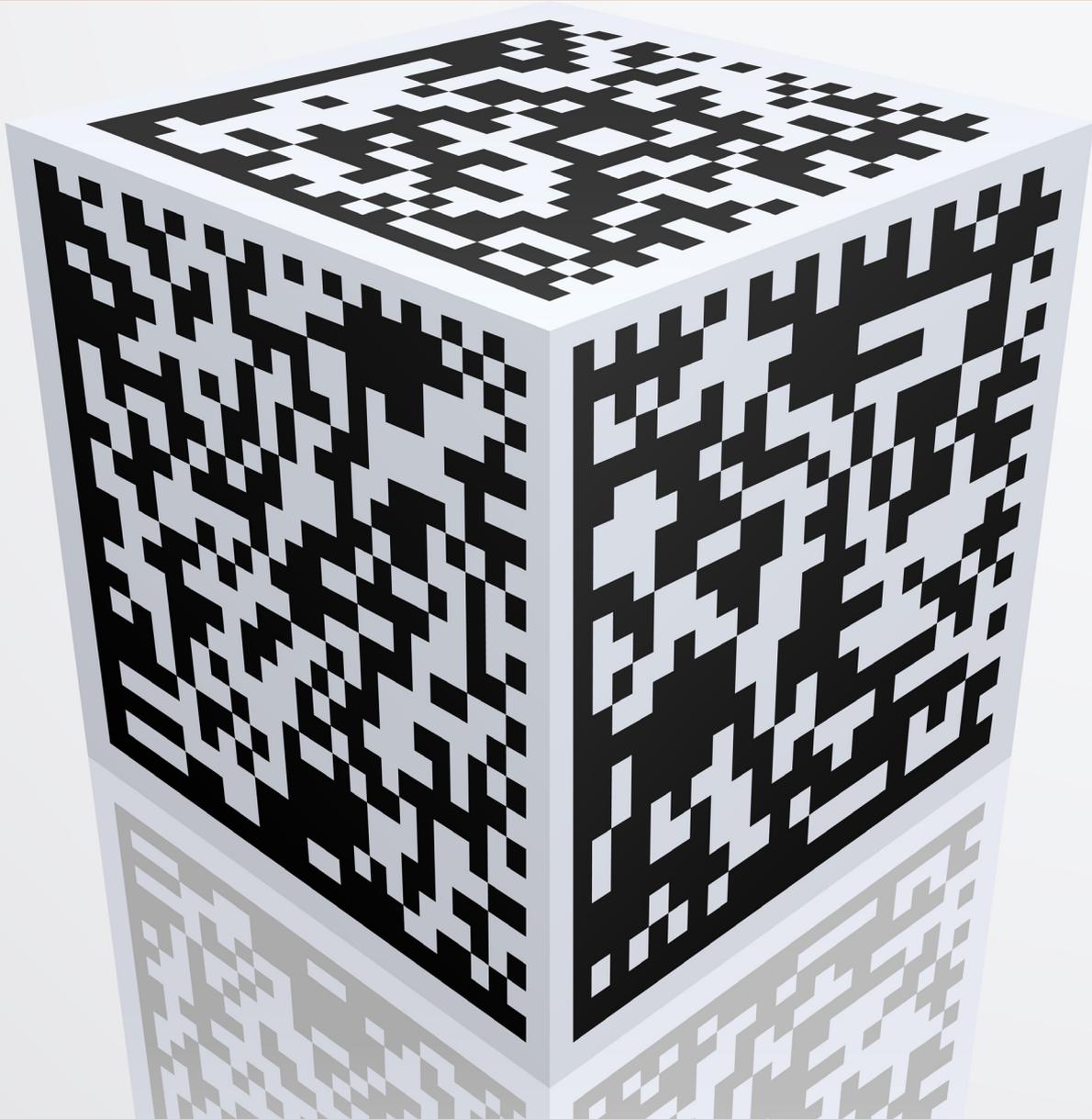
1 ECC 200 Square Symbol Attributes***

Symbol Size Row*	Symbol Size Col*	Data Region Size	Data Region No.	Mapping Matrix Size	Total Codewords Data	Total Codewords	Reed-Solomon Block Data	Reed-Solomon Block Error	Inter-leaved	Data Capacity Num Cap.	Data Capacity Alphanum. Cap.	Data Capacity Byte Cap.	Error Correction Overhead %	Max. Correctable Codeword 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	22x22	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**					

ECC 200 Rectangular Symbol Attributes***

Symbol Size Row*	Symbol Size Col*	Data Region Size	Data Region No.	Mapping Matrix Size	Total Codewords Data	Total Codewords Error	Reed-Solomon Block Data	Reed-Solomon Block Error	Inter-leaved Blocks	Data Capacity Num Cap.	Data Capacity Alphanum. Cap.	Data Capacity Byte Cap.	Error Correction Overhead %	Max. Correctable Codeword 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	7/11
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

Notes:

*   Symbol size does not include Quiet Zones.

**   In the largest symbol (144x144), the first eight Reed-Solomon blocks shall be 218 codewords long encoding 156 data codewords. The last two blocks shall encode 217 codewords (155 data codewords). All the blocks have 62 error correction codewords.

***   Equivalent to Table 7 in the international standard ISO-16022, second edition,2006-09-15.

The square format is divided into 4 to 36 data regions for symbols sized 32 by 32 modules and larger. The rectangular format symbols may also be divided into two data regions. Each data region is separated from the other regions by alignment patterns that consist of an alternating pattern of ones and zeroes and a solid line of ones (a dark line when there is no reflectance reversal). The illustration below shows a four-segment square symbol on the left and a two-segment rectangular symbol on the right, each with hypothetical data shown to create the effect.

Segmented GS1 DataMatrix Symbols: Square and Rectangular Formats
(These illustrations are enlarged so that typical alignment patterns can be easily seen.)
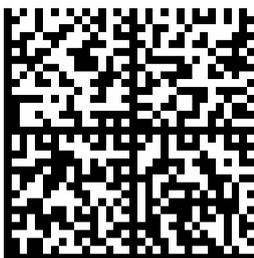
Data transmission and symbology identifier prefixes

The GS1 System requires the use of symbology identifiers. GS1 DataMatrix uses the symbology identifier of "]d2" (see the format illustrated below) for GS1 System compliant symbols that have a leading FNC1 character. This indicates that Application Identifier (AI) data is encoded equivalent to the symbology identifier "]C1" for GS1-128 Symbols and "]e0" for GS1 DataBar and Composite Symbols. For more information on symbology identifiers, see the International standard ISO/IEC 15424 Information technology — Automatic identification and data capture techniques — Data Carrier Identifiers.

For example, a GS1 DataMatrix Symbol encoding AI(01) Element String 10012345678902 produces the transmitted data string "]d20110012345678902." Data transmission follows the same principles applying to the concatenation of AI Element Strings in any GS1 Barcode that encodes Application Identifiers.

Symbology Identifier for DataMatrix ECC 200

	Message Content	Separator
]d2	Standard AI Element Strings	None

Width and height of a module (X)

The range of the X-dimensions will be defined by the application specification, having due regard to the availability of equipment for the production and reading of symbols and complying with the general requirements of the application.

The X-dimension shall be constant throughout a given symbol. The X-dimension should apply to both the width and height of the modules.
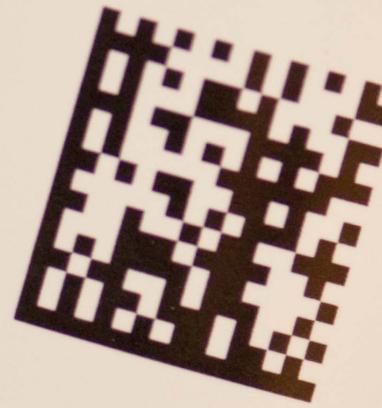
Light margin

The required light margin is 1X.

Symbol quality grade

The International Standard ISO/IEC 15415 Information technology - Automatic identification and data capture techniques - Barcode symbol print quality test specification - Two dimensional symbols methodology shall be used for measuring and grading GS1 DataMatrix.

The print quality grade is measured by verifiers that comply with the standard. The grade includes a grade level, measuring aperture, the wavelength of light used for the measurement, and the illumination angle relative to the symbol.

A symbol grade is only meaningful if it is reported in conjunction with the illumination and aperture used. It should be shown in the format grade/aperture/light/angle, where:

"grade" is the overall symbol grade as defined in ISO/IEC 15415 Information technology - Automatic identification and data capture techniques - Barcode symbol print quality test specification - Two-dimensional symbols (e.g., the arithmetic mean to one decimal place of the Scan Reflectance Profile or scan grades). For GS1 DataMatrix, the grade number may be followed by an asterisk (*) which indicates that the surroundings of the symbol contain extremes of reflectance that may interfere with reading. For most applications, this should be specified as causing the symbol to fail.

"aperture" is the diameter in thousandths of an inch (to the nearest thousandth) of the synthetic aperture defined in ISO/IEC 15415 Information technology - Automatic identification and data capture techniques - Barcode symbol print quality test specification - Two-dimensional symbols.

"light" defines the illumination: A numeric value indicates the peak light wavelength in nanometres (for narrow band illumination); the alphabetic character W indicates that the symbol has been measured with broadband illumination (white light) the spectral response characteristics of which must imperatively be defined or have their source specification clearly referenced.

"angle" is an additional parameter defining the angle of incidence (relative to the plane of the symbol) of the illumination. It shall be included in the reporting of the overall symbol grade when the angle of incidence is other than 45 degrees. Its absence indicates that the angle of incidence is 45 degrees.

Note: This international standard provides for 30 degrees and 90 degrees illumination in addition to the default 45 degrees.

The aperture is normally specified as being 80% of the minimum X-dimension allowed for the application. The printing method must produce the GS1 DataMatrix "L" pattern with gaps between the dots less than 25% of the specified aperture. If symbols with greater than the minimum X dimension are allowed by the application, the same absolute maximum gap dimension must be maintained.

Examples:

2.8/05/660 would indicate that the average of the grades of the Scan Reflectance Profiles, or of the scan grades, was 2.8 when these were obtained with the use of a 0.125 millimetre aperture (ref. no. 05) and a 660 nanometre light source, incident at 45 degrees.

2.8/10/W/30 would indicate the grade of a symbol intended to be read in broadband light, measured with light incident at 30 degrees and using a 0.250 millimetre aperture (ref. no. 10), but would need to be accompanied either by a reference to the application specification defining the reference spectral characteristics used for measurement or a definition of the spectral characteristics themselves.

2.8/10/670* would indicate the grade of a symbol measured using a 0.250 millimetre aperture (ref. no. 10), and a 670 nanometre light source, and indicates the presence of a potentially interfering extreme reflectance value in the surroundings of the symbol.

Verification of GS1 DataMatrix symbols

The pass grade for GS1 DataMatrix barcode symbols is C but the aperture used for the test will depend on the method of marking and the application.

Because of the physics of optical systems, label based GS1 DataMatrix should be printed at approximately 1.5 times the equivalent printing density allowed for linear symbols in the same application.

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 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 (AI01) plus Serial Number (AI21).

The effective aperture for GS1 DataMatrix 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 Park 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 AIM DPM-1-2006.

GS1 New Zealand and GS1 Australia are equipped with verifiers for GS1 DataMatrix barcodes. Tests should be requested in the usual way.

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 DataMatrix or ECC 200.

Human Readable Interpretation of GS1 DataMatrix Symbols

The Human Readable Interpretation of the primary Application Identifier (AI) Element String encoded in the GS1 DataMatrix Symbol should be shown with the symbol. How the human readable data will be shown shall be determined by the specific application guidelines. Typical conventions, as used for GS1 DataBar and Composite Component Symbols, place the key information, such as the Global Trade Item Number (GTIN), in the human readable data underneath the barcode, while secondary information is placed above. The characters should be clearly legible (such as OCR-B) and must be obviously associated with the symbol.

AIs should be clearly recognisable to facilitate key entry. This is achieved by putting the AI between parentheses in the Human Readable Interpretation.

Note: The parentheses are not part of the data and are not encoded in the barcode, following the same principles that apply to GS1-128 Symbols and GS1 DataBar Expanded Symbols.

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.

Appendix 10 GS1 QR Code symbology

GS1 QR Code is a standalone, two-dimensional matrix symbology that is made up of square modules arranged in an overall square pattern, including a unique finder pattern located at three corners of the symbol.

This Basic User Guide provides only a brief technical description and overview of the GS1 QR Code symbology. A more detailed technical specification can be found in the International Standard ISO/IEC 18004 QR Code 2005 barcode symbology specification. The GS1 system has adopted GS1 QR Code partly because, like GS1 DataMatrix, GS1 QR Code can encode GS1 system data structures and offers other technical advantages. Its compact design and the existence of various production methods that accommodate placing the symbology onto various substrates offer certain advantages over other symbologies currently in the GS1 system.

QR Code 2005 is the only member of the QR Code family that supports GS1 system data structures, including Function 1 Symbol Character. ISO/IEC QR Code 2005 also contains specifications for Micro QR Code, but this symbology is not supported for the GS1 system. QR Code 2005 uses Reed-Solomon error correction (four selectable levels of error correction are specified), and this feature helps correct for partially damaged symbols. In the remainder of this section, the ISO/IEC QR Code 2005 is assumed when the symbology is described as GS1 QR Code. QR Code 2005 is similar in stability to ISO versions of current GS1 system symbologies.

Implementation of GS1 QR Code shall be done per approved GS1 system application standards. This section will not describe the specific applications. The user needs to refer to specific application standards in other sections of the GS1 General Specifications.

GS1 QR Code symbols are read by two-dimensional imaging scanners or vision systems. Most other scanners that are not two-dimensional imagers can not read GS1 QR Code. GS1 QR Code symbols are restricted for use with new niche applications that will involve imaging scanners within mobile devices.

GS1 QR Code features and symbol basics

GS1 QR Code is a subset of ISO/IEC QR Code 2005 that is a matrix symbology with the following characteristics:

Formats

- QR Code, with full range of capabilities and maximum data capacity.

- Not supported for the GS1 system: Micro QR Code, with reduced overhead, some restrictions on capabilities and reduced data capacity.

Encodable character set

- numeric data (digits 0 - 9)
- alphanumeric data (digits 0 - 9; upper case letters A -Z; nine other characters: space, $ % * + - . / :);
- Byte data (default: ISO/IEC 8859-1; or other sets as otherwise defined In byte mode, data is encoded at 8 bits per character. In closed-system national or application-specific implementations of QR Code 2005, an alternative 8-bit character set, for example as defined in an appropriate part of ISO/IEC 8859, may be specified for byte mode. When an alternative character set is specified, however, the parties intending to read the QR Code 2005 symbols require to be notified of the applicable character set in the application specification or by bilateral agreement.
- Not supported for the GS1 system: Kanji characters (Kanji characters in QR Code 2005 can be compacted into 13 bits.

Representation of data

A dark module is nominally a binary one and a light module is nominally a binary zero. However, reflectance reversal is provided as an option.

Symbol size (not including Quiet Zone)

GS1 QR Code symbols: 21 x 21 modules to 177 x 177 modules (Versions 1 to 40, increasing in steps of four modules per side).

Data characters per symbol

Maximum QR Code symbol size, Version 40-L:

- maximum QR Code symbol size, Version 40-L:
- numeric data: 7,089 characters.
- alphanumeric data: 4,296 character.
- Byte data: 2,953 characters.
- Kanji data: 1,817 characters (Not supported for the GS1 system).

Selectable error correction:

Four levels of Reed-Solomon error correction (referred to as L, M, Q and H in increasing order of capacity) allowing recovery of:

- L   7% of the symbol codewords
- M   15% of the symbol codewords.
- Q   25% of the symbol codewords.
- H   30% of the symbol codewords.

Orientation independence:

Both rotation and reflection. The QR Code examples on the next page shows a QR Code 2005 symbol in normal colour and with reflectance reversal in both normal and mirror image orientations.

Summary of additional features

The use of the following additional features is optional in QR Code 2005; some of these features are not supported for GS1 system use.

Reflectance reversal

Symbols are intended to be read when marked so that the image is either dark on light or light on dark as illustrated below. The specifications in this document are based on dark images on a light background, therefore in the case of symbols produced with reflectance reversal references to dark or light modules should be taken as references to light or dark modules respectively.

Mirror imaging

The arrangement of modules defined in this International Standard represents the "normal" orientation of the symbol. It is, however, possible to achieve a valid decode of a symbol in which the arrangement of the modules has been laterally transposed. When viewed with the finder patterns at the top left, top right and bottom left corners of the symbol, the effect of mirror imaging is to interchange the row and column positions of the modules.

Examples of QR Code 2005 symbols

normal orientation and normal
reflectance arrangement

normal orientation and
reversed reflectance

mirror image orientation and
normal reflectance arrangement

mirror image orientation
and reversed reflectance

Not supported for the GS1 system: Structured append

This allows files of data to be represented logically and continuously in up to 16 QR Code 2005 symbols. These may be scanned in any sequence to enable the original data to be correctly reconstructed. Structured Append is not available with Micro QR Code symbols.

Not supported for the GS1 system: Extended channel interpretations

This mechanism enables data using character sets other than the default encodable set (e.g. Arabic, Cyrillic, Greek) and other data interpretations (e.g. compacted data using defined compression schemes) or other industry-specific requirements to be encoded.

GS1 QR Code symbology

The technical description of GS1 QR Code contained within this section provides additional information based on ISO/IEC technical standard 18004 and it is provided as a further aid in the development of specific applications.

GS1 QR Code square format

GS1 QR Code is printed in a square format. The square format has a large range of sizes. The largest symbol (177 X 177 modules, Error Correction Level = L) can encode up to 7089 digits or 4296 alphanumeric characters technically, however permissible data is specified by the application standards.

GS1 QR Code symbol sizes

GS1 QR Code symbology has multiple sizes to match various data content GS1 QR Code symbols have 40 sizes in a square format ranging from 21 by 21 modules up to 177 by 177 modules, not including the 4-X surrounding Quiet Zone.

The term "codeword" is used often to describe attributes concerning the encoding of data into GS1 QR Code. A codeword is defined as: "A symbol character value. An intermediate level of coding between source data and the graphical encoding in the symbol." Codewords are typically eight bits of data.

GS1 QR Code symbol size and data capacity

Version	Modules / side	Data capacity (codewords)		Version	Modules / side	Data capacity (codewords)
1	21	26		21	101	1 156
2	25	44		22	105	1 258
3	29	70		23	109	1 364
4	33	100		24	113	1 474
5	37	134		25	117	1 588
6	41	172		26	121	1 706
7	45	196		27	125	1 828
8	49	242		28	129	1 921
9	53	292		29	133	2 051
10	57	346		30	137	2 185
11	61	404		31	141	2 323
12	65	466		32	145	2 465
13	69	532		33	149	2 611
14	73	581		34	153	2 761
15	77	655		35	157	2 876
16	81	733		36	161	23 034
17	85	815		37	165	3 196
18	89	901		38	169	3 362
19	93	991		39	173	3 532
20	97	1,085		40	177	3 706

GS1 QR Code symbol attributes for the first ten versions of the symbol

The required light margin is 4X (not included in the dimensions in the previous table).

Version	Error correction level	Number of data codewords	Data capacity Numeric	Alpha-numeric	Byte	Kanji
1	L	19	41	25	17	10
	M	16	34	20	14	8
	Q	13	27	16	11	7
	H	9	17	10	7	4
2	L	34	77	47	32	20
	M	28	63	38	26	16
	Q	22	48	29	20	12
	H	16	34	20	14	8
3	L	55	127	77	53	32
	M	44	101	61	42	26
	Q	34	77	47	32	20
	H	26	58	35	24	15
4	L	80	187	114	78	48
	M	64	149	90	62	38
	Q	48	111	67	46	28
	H	36	82	50	34	21
5	L	108	255	154	106	65
	M	86	202	122	84	52
	Q	62	144	87	60	37
	H	46	106	64	44	27
6	L	136	322	195	134	82
	M	108	255	154	106	65
	Q	76	178	108	74	45
	H	60	139	84	58	36
7	L	156	370	224	154	95
	M	24	293	178	122	75
	Q	88	207	125	86	53
	H	66	154	93	64	39
8	L	194	461	279	192	118
	M	154	365	221	152	93
	Q	110	259	157	108	66
	H	86	202	122	84	52
9	L	232	552	335	230	141
	M	182	432	262	180	111
	Q	132	312	189	130	80
	H	100	235	143	98	60
10	L	274	652	395	271	167
	M	216	513	311	213	131
	Q	154	364	221	151	93
	H	122	288	174	119	74

Data transmission and symbology identifier prefixes

The GS1 system requires the use of symbology identifiers. GS1 QR Code uses the symbology identifier of "]Q3" (see the format illustrated below) for GS1 system compliant symbols that have a leading FNC1 character. This indicates that Application Identifier (AI) data is encoded equivalent to the symbology identifier "]C1" for GS1-128 symbols,]d2 for GS1 DataMatrix symbols and "]e0" for GS1 DataBar and Composite symbols. For more information on symbology identifiers, see the International standard ISO/IEC 15424 Information technology — Automatic identification and data capture techniques — Data Carrier Identifiers.

For example, a GS1 QR Code symbol encoding AI(01) element string 10012345678902 produces the transmitted data string "]Q30110012345678902." Data transmission follows the same principles that apply to the concatenation of AI element strings in any GS1 barcode that encodes Application Identifiers (see section XXXX.).

Symbology identifier for GS1 QR Code

	Message content	Separator
]Q3	Standard AI element strings	None

Width and height of a module (X)

The range of the X-dimensions will be defined by the application specification, having due regard to the availability of equipment for the production and reading of symbols and complying with the general requirements of the application.

The X-dimension SHALL be constant throughout a given symbol. The X-dimension SHOULD apply to both the width and height of the modules.

Symbol quality grade

The International Standard ISO/IEC 15415 Information technology - Automatic identification and data capture techniques – Barcode symbol print quality test specification - Two-dimensional symbols methodology SHALL be used for measuring and grading GS1 QR Code Symbols. The print quality grade is measured by verifiers that comply with the standard. The grade includes a grade level, measuring aperture, the wavelength of light used for the measurement, and the illumination angle relative to the symbol.

A symbol grade is only meaningful if it is reported in conjunction with the illumination and aperture used. It should be shown in the format grade/aperture/light/angle, where:

- "grade" is the overall symbol grade as defined in ISO/IEC 15415 Information technology - Automatic identification and data capture techniques – Barcode symbol print quality test specification - Two-dimensional symbols (e.g., the arithmetic mean

to one decimal place of the Scan Reflectance Profile or scan grades). For GS1 QR Code, the grade number may be followed by an asterisk (*) which indicates that the surroundings of the symbol contain extremes of reflectance that may interfere with reading. For most applications, this should be specified as causing the symbol to fail.

- "aperture" is the diameter in thousandths of an inch (to the nearest thousandth) of the synthetic aperture defined in ISO/IEC 15415 Information technology - Automatic identification and data capture techniques – Barcode symbol print quality test specification - Two-dimensional symbols.

- "light" defines the illumination: A numeric value indicates the peak light wavelength in nanometres (for narrow band illumination); the alphabetic character W indicates that the symbol has been measured with broadband illumination (white light) the spectral response characteristics of which must imperatively be defined or have their source specification clearly referenced.

- "angle" is an additional parameter defining the angle of incidence (relative to the plane of the symbol) of the illumination. It SHALL be included in the reporting of the overall symbol grade when the angle of incidence is other than 45 degrees. Its absence indicates that the angle of incidence is 45 degrees.

The aperture is normally specified as being 80% of the minimum X-dimension allowed for the application.

Examples:

- 2.8/05/660 would indicate that the average of the grades of the Scan Reflectance Profiles, or of the scan grades, was 2.8 when these were obtained with the use of a 0.125mm aperture (ref. no. 05) and a 660nanometre light source, incident at 45 degrees.

- 2.8/10/W/30 would indicate the grade of a symbol intended to be read in broadband light, measured with light incident at 30 degrees and using a 0.250mm aperture (ref. no. 10), but would need to be accompanied either by a reference to the application specification defining the reference spectral characteristics used for measurement or a definition of the spectral characteristics themselves.

- 2.8/10/660* would indicate the grade of a symbol measured using a 0.250mm aperture (ref. no. 10), and a 660 nanometre light source, and indicates the presence of a potentially interfering extreme reflectance value in the surroundings of the symbol.

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.

Human readable interpretation of GS1 QR Code symbols

Human readable interpretation rules for GS1 QR Symbols are the same as for all GS1 barcodes.

This User Guide provides a summary of the GS1 specifications for the barcoding of goods that are handled in open trade. If the application of any of this advice is unclear, please contact GS1 New Zealand for clarification.

The complete GS1 specifications are available free of charge via the GS1 New Zealand website at www.gs1nz.org.

Further information and advice are also available from the barcode manager at each relevant retailer and wholesaler, as well as from the staff of GS1 New Zealand. Initial calls to GS1 New Zealand should be made via the membership services GS1's Support Centre on 0800 10 23 56 or email info@gs1nz.org.

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