



# How to print GS1 bar codes on-demand

There are various types of on-demand bar code printing equipment, and the choice and descriptions can be very technical and confusing. This document explains the types of on-demand bar code printers available, provides guidance on the different methods of printing and will help in the choice of equipment.

This document is intended for new users who need to print their own bar codes, and it will also help other users to evaluate their existing printing processes against others. The guidance may also be useful for users wishing to outsource their bar code printing by buying in pre-printed labels/packaging.

If further technical information is required you are advised to contact your proposed equipment supplier. Other GS1 UK documents that will be helpful are:

- Bar coding - getting it right
- Ink jet printing GS1-128 and ITF-14 bar codes on to fibreboard cases
- How to choose software for digital bar code production
- Bar coding - getting it right with thermal printers

This document does not cover bar code generating software, and assumes users have an understanding of the GS1 System that includes the sizes, colours and locations of bar codes on products. If more information about these aspects is required, please see the GS1 General Specifications at [www.gs1uk.org](http://www.gs1uk.org).

## Why use an on-demand bar code printer

Any of the GS1 bar codes can be included in the artwork of product packaging or generic packaging, but many products have minimal packaging, and bar coded labels may be applied directly to the product. There may also be small production runs or test products where the incorporation of bar codes into the design packaging is not feasible, and some companies may ink jet print bar codes direct onto fibreboard outer cases. On-demand printers are typically used to print bar codes as and when they are required, both onto labels and directly onto outer cases.

Most users of GS1-128 bar codes will print these bar codes on demand as they usually incorporate variable information (such as batch number or best before or expiry dates), and the bar codes cannot be pre-printed economically.

Your trade customers may request bar codes so that they can scan your products in their outer cases, and then scan the individual products as they are either used or sold. Many companies are also implementing their own scanning systems to record the movement of stock and it may be necessary to bar code some products that are not source marked. If companies are to see the most benefit from using the GS1 System they will both bar code their own products and scan all the incoming raw materials that have been source-marked by their suppliers.

## General considerations

Any printing method chosen must be able to produce bar codes that can be scanned anywhere in the supply chain. If the bar code printing is being outsourced to another company, the brand owner should agree with the printer who is to be responsible for ensuring and checking the bar code quality. Wherever bar codes are created, it is recommended that the quality of the symbols is checked and verified before distribution to avoid problems and the potential rejection of the goods.

On-demand printers will be driven by appropriate software that is either integrated into the equipment or on a separate computer system. The image of the bar code will be created and then sent to the printer. The

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software provider should be aware of the output device being used, as this has to be matched to the originating software.

All of these printers produce images that are in effect created from series of narrow lines. The width of these lines is determined by the resolution of the printer, which is measured in terms of dots per millimetre or dots per inch. It is important the printer chosen can print a complete number of these narrow lines to make up the width of a complete narrow bar. For example, an 8 dpmm (203 dpi) printer can only print bars that are a multiple of 1/8 mm. Some of the printers listed below have a very high resolution, but those that have low resolutions will only be able to print bar codes of certain sizes. The supplier of the equipment must be aware of the purpose of the on-demand bar code printer so that the correct printer with an appropriate resolution can be provided.

If bar coded labels are used to identify retail trade items (consumer units) or trade item groupings (traded units) only one bar coded label is required. If bar codes are being printed directly onto fibreboard packaging, again only one bar code must be printed.

It is recommended that black bars are used on a white or pale background to ensure the highest quality bar codes.

Users of any of these printers must ensure that:

- The printer is kept in good condition
- Any faults with the printer are identified and fixed
- The correct magnification (x-dimension) is used in relation to the symbol used and the printing process
- The correct data is encoded within the symbol
- Any changes to the printer (resolution, set up) will not result in a loss of bar code quality
- Any adjustment for bar width gain is correctly allowed for

Sophisticated printers may be able to double-check certain faults themselves.

The quality of the bar codes must be verified at intervals during the print production run (and potentially some time after printing) to ensure that consistently high quality bar codes are produced, and that any problems (e.g. worn print heads, toner cartridge needing to be replaced, etc) are identified and rectified as quickly as possible.

NOTE: Careful consideration must be given to the matching of consumables and surfaces. Durability of the image will be affected if not followed.

## **International standards for bar codes**

All printed GS1 bar codes must meet the criteria of ISO/IEC 15416. The quality of the bar codes can be checked using verification equipment that meets the requirements of ISO/IEC 15426-1. Further information about verification is provided in the GS1 UK document 'Bar coding – getting it right'.

## **What types of on-demand bar code printers are available?**

Most on-demand one of the following five printing techniques:

1. Direct thermal
2. Thermal transfer
3. Industrial ink jet
4. Dot matrix
5. Laser

The first three are used by dedicated bar code printing equipment and the last two by general purpose printing devices that may also be used for bar code printing.

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Some specialised digital printing methods, such as digital offset, in-line ink jet or in-line ion deposition are also used for on-demand bar code production, but these are typically used by specialised printing companies. If bar code production is being outsourced, the company must ensure that the bar code requirements are communicated and the final bar codes are of sufficient quality.

The printer may be a stand-alone printer or integrated into an application such as a weighing and labelling system.

## 1. Direct thermal printers

These printers use heat sensitive labels that come into contact with a print head (containing rows of tiny electronic heaters). The heat will create the image of the bar code on the label. Resolution is typically 200 or 300 dpi (equal to 8 dpmm or 12 dpmm) but can go up to 600 dpi.

### Advantages:

- Simpler to load labels than to deal with ribbons and toner
- Create good quality bar codes
- Tend to produce consistently good quality symbols

### Disadvantages:

- Wear and tear on print heads – individual elements can burnout due to direct contact with paper surfaces
- If equipment is set up incorrectly, problems with the print head will cause low quality symbols to be produced
- Cost involved in maintaining and repairing the print head
- The special labels have a relatively short life of six months or less with the background becoming yellow over time and the black print fading to grey (depending on the amount and type of light the labels are exposed to)
- The labels always remain heat sensitive, so if they pass another heated object the area of the labels exposed to the heat will also turn black
- The printer is dedicated to label printing only

## 2. Thermal transfer printers

These printers use a high carbon content wax/resin ribbon that passes between the print head and the labels. The heat from the print head transfers the ink from the ribbon to the label. Resolution is typically 200 or 300 dpi (equal to 8 dpmm or 12 dpmm) but can go up to 600 dpi, and running speeds are typically twice that of direct thermal printers. These printers can usually be used as direct thermal printers if the appropriate label stock is used.

### Advantages:

- Printers are fast and quiet
- The print heads last longer than with direct thermal printers
- Can be small and economical for low-volume applications

### Disadvantages:

- Incorrectly set up equipment, and problems with the print head and ribbons will cause low quality symbols to be produced
- In addition to labels, the printer consumes one-pass ribbons

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### 3. Ink jet printers

The print head projects the ink onto the required surface at a set distance. The printer does not come into direct contact with the surface, and the ink will either be absorbed into the surface of the paper or in the case of wax based inks the ink will adhere to the surface. The bar code is printed directly onto the product packaging and no labels are used. There are ranges of resolutions for ink jet printers.

Advantages:

- Ink jet printers can be used for other tasks
- Low running costs and coloured inks are often available at reasonable cost
- There are a wide range of ink jet printers available allowing non contact coding onto virtually any surface
- Provide online flexibility and reduces set-up time
- Use of generic cases could reduce packaging costs and inventory

Disadvantages:

- Due to the complexity of the printing process more attention to quality and detail needs to be given (see the GS1 UK document *Ink jet printing GS1-128 and ITF-14 bar codes on to fibreboard cases* for more information)
- Incorrectly set up equipment, and problems with the print head will cause low quality symbols to be produced

### 4. Dot matrix printers

The dot matrix print head strikes dots of pressure to a carbon ribbon onto a label to create the image. Print heads have typically 9 to 24 pins to create the image. They generally produce lower quality bar codes than the other printing techniques, and are not recommended for use.

Advantages:

- Economical choice where speed and quality is not an issue/where impact printing is necessary
- The printer can be used for other tasks

Disadvantages:

- The printed images will be of low resolution (low print quality) and therefore bar codes will need to be larger to ensure readability
- Printers generally slow and noisy
- Ink ribbons may need to be replaced often to avoid substandard bar codes

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## 5. Laser printer

A laser printer draws the image onto a static surface within the printer. The toner (powder) is applied to the areas un-touched by the laser image and the completed image is transferred to the paper by a hot roller. Suitable PC based software is required to print the required bar code image. Many normal office printers are laser printers. Resolution may be up to 600 dpi.

### Advantages:

- Good for printing sheets of labels at a time rather than continuous dispensing of labels
- The printer can be used for other tasks
- Economical for short production runs

### Disadvantages:

- The heat may cause problems with specialist labels (e.g. plastics or synthetics)
- Uneconomical to print single bar codes
- Potential problems with labels peeling off and getting caught inside the printer

## Approximate cost per printer

The figures included in the following table are for guidance only.

On-demand printer	Approximate cost range
Direct Thermal	£150 - £10,000+
Thermal Transfer	£250 - £10,000+
Ink Jet	£6,000 – £10,000+
Dot Matrix	£100 - £1,000
Laser	£250 - £20,000

## Printer requirements

The answers to the following questions should form the basis of a requirements document that can be used as the basis for sourcing an appropriate printing solution.

1. Packaging artwork - could the bar codes be included here?
2. Application - how do you want the bar code to be applied to the item?
  - Printed and applied label
  - Hanging tab label
  - Tray drop in card
  - Directly applied whilst on a moving conveyor belt
  - Applied manually by hand, etc.
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3. Quantities:
  - How many bar codes do you have to print on the product?
  - How many bar codes do you need to print every day/week/month?

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4. Positioning:
    - Where should the bar codes be positioned?
    - Is the space available surrounded by additional pre-printed artwork?
    - If more than one symbol is required, which sides do you want them to be printed on?
    - Would this require more than one printer or would the product need to be turned to print on the additional side? Are there additional text/logos/information that may affect the label size?
  5. Application:
    - What type of product will the bar code/label be applied to?
    - Labels for ambient, chilled and frozen products generally require different adhesives and label stocks
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  6. Type and size:
    - What type and size of bar code needs to be printed? EAN-8, EAN-13, UPC-E, UPC-A, ITF-14 or GS1-128. The answer will affect the size of label required, and some printers are unable to print larger bar codes.
  7. Colour:
    - Will you be using black ink on a white background or is a different colour required?
  8. Labels and surface:
    - If labels are not being used and the bar codes will be printed directly onto the packaging, what type of surface will the bar code be printed onto?
    - The bar code should be printed on the flattest surface possible.
    - Will you be using corrugated board, plastic or wax-coated packaging, with shiny or matt surfaces
    - Will the colour of the background be pale enough to achieve the correct verification grade? The porosity of the material also needs to be considered
  11. Will you be printing long or short runs or a mixture of both?
  12. Printers and location:
    - How many printers will be required?
    - Where will they be located?
    - Will they require access to a network?
    - Does the location have any particular environmental conditions, for example, excessive or low light, dust, etc?
  13. What budget is available? Take into account costs such as:
    - equipment purchase
    - installation
    - training, servicing
    - parts replacement
    - ink/toner cartridge replacement cost, etc.



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