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# Maggio Data Forms

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## THE BARCODE GAME... ...WANNA PLAY!

### Barcode Reference Guide

#### What is a barcode?

Barcodes are machine-readable symbols made of patterns of black and white bars and stripes, or in the case of 2D barcodes, checkerboard-like grids.

There are different styles of barcodes called symbologies which are shown and described inside.

#### What is in a barcode?

Each barcode contains information that is encoded within the barcode. The data is read by a barcode scanner and is often used in conjunction with databases. Barcodes do not require human-input, can be read by automated machines, and are virtually error-free.

#### How are barcodes used?

Barcodes are used on most products we buy at a retail store (UPC and EAN). They are also used on packages for tracking (FedEx, UPS and USPS). Many manufacturing processes utilize barcodes to control and monitor production.

Barcodes are often found on I.D. cards and turn-around documents for accurate and economical data entry.

## CODE 39



**Aliases:** Code 3-of-9  
**Character Set:** All 36 Alphanumeric, plus - . space \$ / + %  
**Code Type:** Discrete  
**Character Self-Checking:** Yes  
**Symbol Length:** Variable  
**Symbol Check Character:** One, Optional  
**Bidirectionally Decodable:** Yes

**Code 39 is the most commonly used barcode format because it enables numbers, upper case letters, and some punctuation marks (Capital Letters A-Z, Numbers 0-9, the "space" character, and the symbols: - + / \$ . %)** to be barcoded.

Code 39 is a variable length format, allowing for encoding any number of digits. This format has become the standard for Government, Manufacturing, the Barcode Industry, Education, and Business applications.

Each Code 39 barcode consists of a leading quiet zone, a start symbol character, symbol characters representing the data, a stop symbol character and a trailing quiet zone. Code 39 symbol characters are each represented by 5 bars and 4 intervening spaces. Characters are separated by an "intercharacter gap".

## Interleaved 2/5



**Aliases:** Interleaved 2-of-5; I-2/5; or ITF  
**Character Set:** All 10 digits  
**Code Type:** Continuous  
**Character Self-Checking:** Yes  
**Symbol Length:** Fixed, Multiple  
**Symbol Check Character:** One, Optional  
**Bidirectionally Decodable:** Yes

**Interleaved 2 of 5 Barcode Format is a numeric only code that prints out a little larger than the UPC Barcode when ten digits are encoded.**

The Interleaved 2 of 5 is an excellent choice for numeric only applications, because it has the flexibility of having from 2 to 30 digits. The Interleaved 2 of 5 code requires an even numbers of digits to be encoded. A leading 0 must be added if the digit count is not even. Each Interleaved 2/5 symbol consists of a leading quiet zone, a start pattern, symbol characters representing the data, a stop pattern and a trailing quiet zone.

Each symbol is formed from a series of one or more data character pairs. Each pair is coded into a series of five bars and five spaces with the bars representing the more significant digit of the pair while the white spaces represent the less significant digit.

## Code 128



**Aliases:** None  
**Character Set:** All 128 ASCII characters, all 128 extended ASCII characters, plus 4 non-data function characters  
**Code Type:** Continuous  
**Character Self-Checking:** Yes  
**Symbol Length:** Variable  
**Symbol Check Character:** One, Mandatory  
**Bidirectionally Decodable:** Yes  
**Options:** FNC 3 Reader Initialization

**Code 128 is capable of encoding all 128 ASCII characters, plus all 128 extended ASCII characters and 4 non-data function characters. It allows numeric data to be represented in a compact, double-density mode, two data digits for every symbol character.**

Each Code 128 symbol uses 2 independent self-checking features, character checking via parity and a modulus 103 check character. This minimizes the possibility of reader substitution errors. Code 128 Barcode format is a very compact barcode for data with all numeric information. Alphanumeric information can also be encoded, but at the expense of losing the "very compact" benefit. The compact size of the barcode printed with the Code 128 when using only numeric digits is achieved by using "double density" (two numbers are included in one character width). When alphanumeric data is encoded, however, Code 128 uses "single density", and the barcodes are twice as long. This is not a simple barcode format to use, as there are several Code 128 subsets, each with specific specifications and limitations.

## UPC/EAN



**Aliases:** None, though there are a couple different versions of each  
**Character Set:** All 10 digits  
**Character Self-Checking:** Yes  
**Symbol Length:** Fixed (see below)  
**Symbol Check Character:** One, Mandatory

**UPC and EAN are barcode symbologies with a character set consisting of the numeric characters 0-9 and a check digit.**

The UPC A format supports 11 characters plus a check character, the UPC E format supports 5 characters plus a check character, the EAN 13 format supports 12 characters plus a check character, and the EAN 8 format supports 7 characters plus a check character.

The UPC barcode format is the standard barcode format for items that are for sale to the public. Probably the largest user of the UPC code is your local supermarket. The UPC barcode format is used to encode a 12 digit number. The first number is the number system character, the next five are the manufacturer's number, the next five are the specific product number, and the last digit is the checksum character. This barcode format only encodes numeric information and must have 12 characters in length (exactly).

## Postal Barcodes



**Aliases:** Postal barcode  
**Character Set:** All 10 digits  
**Character Self-Checking:** Yes  
**Symbol Length:** Fixed  
**Symbol Check Character:** One, Mandatory

**POSTNET is a unique type of barcode used and developed by the USPS (United States Postal Service) for optimizing the delivery of mail and parcel packages.**

It is unique in that it does not use the common bars and spaces present in all other barcode types where the width and of the bars and spaces encodes the data within the symbol. Instead it uses a combination of tall and short bars separated by space to encode the specific numbers. It is also unique in that there is a set, standard size that should not be deviated from when printing the barcode.

POSTNET contains a single character that is used as a start and stop code. The start/stop code character has been mapped to the "/" character. This character is a single tall bar. This character is required.

## Codabar



**Aliases:** None  
**Character Set:** All 10 digits plus - \$ : / . + and 4 start/stop characters: A B C D  
**Code Type:** Discrete  
**Character Self-Checking:** Yes  
**Symbol Length:** Variable  
**Symbol Check Character:** Optional  
**Bidirectionally Decodable:** Yes  
**Options:** Alternate Constant Character Width Font Symbol Concatenation

**Codabar is a discrete barcode symbology offering 16 data characters plus 4 unique start/stop characters.**

Codabar can encode the digits 0 through 9, six symbols (-.\$/+), and the start/stop characters A, B, C, D, E, \*, N, or T. The start/stop characters must be used in matching pairs and may not appear elsewhere in the barcode. Codabar is used in libraries, blood banks, the overnight package delivery industry, and a variety of other information processing applications.

There is no checksum defined as part of the Codabar standard, but some industries (libraries, for example) have adopted their own checksum standards. Many libraries use a system which includes 13 digits plus a checksum.

**The barcode standards requires a quite zone of 10 times the smallest bar used, or 1/10 of an inch whichever is bigger. It has been proven however that most bar code readers do not work well if the quiet zone is less than 1/4 of an inch.**

## 2d Barcodes

2D means 'two dimensional'. 2D barcodes contain more information than conventional one dimensional linear barcodes. Conventional barcodes get wider as more data is encoded. 2D barcodes make use of the vertical dimension to pack in more data.

There are about 40 different types of 2D barcodes - many are specialized for specific industries. Here's just a few:

### PDF417 - Portable Data File



- Public domain format
- Has spawned an Open Source decoder and encoder project
- Used by Alaska DMV and USPS for generation of postage. It is an Airline Industry boarding code standard.

### Data Matrix



- A few bytes... up to 2 kilobytes.
- Ability to encode fifty characters in a symbol that is readable at 2 or 3 mm<sup>2</sup> and the fact that the code can be read with only a 20% contrast ratio.

### Aztec



- The smallest Aztec Code symbol encodes 13 numeric or 12 alphabetic characters. The largest Aztec Code symbol encodes 3832 numeric or 3067 alphabetic characters or 1914 bytes of data. There is also a "small" Aztec code which goes up to 95 characters.
- Like PDF 417, it is an Airline Industry boarding code standard.
- Several airlines send Aztec codes to passengers' mobile phones.

### QR Code



Although initially used for tracking parts in vehicle manufacturing, QR Codes are now used in a much broader context, including both commercial tracking applications and convenience-oriented applications aimed at mobile phone users (known as mobile tagging).

QR Codes storing addresses and URLs may appear in magazines, on signs, buses, business cards or just about any object that users might need information about. Users with a camera phone equipped with the correct reader software can scan the image of the QR Code causing the phone's browser to launch and redirect to the programmed URL. This act of linking from physical world objects is known as a hardlink or physical world hyperlinks.

Users can also generate and print their own QR Code for others to scan and use by visiting one of several free QR Code generating sites.

## Barcode Symbologies

The mapping between messages and barcodes is called a symbology. The specification of a symbology includes the encoding of the single digits/characters of the message as well as the start and stop markers into bars and space, the size of the quiet zone required to be before and after the barcode as well as the computation of a checksum.

**Symbologies can be classified mainly by two properties:**

**Continuous vs. discrete:** Characters in continuous symbologies abut, with one character ending with a space and the next beginning with a bar, or vice versa. Characters in discrete symbologies begin and end with bars; the intercharacter space is ignored, as long as it is not wide enough to look like the code ends.

**Two-width vs. many-width:** Bars and spaces in two-width symbologies are wide or narrow; how wide a wide bar is exactly has no significance as long as the symbology requirements for wide bars are adhered to (usually two to three times as wide than a narrow bar). Bars and spaces in many-width symbologies are all multiples of a basic width called the module; most such codes use four widths of 1, 2, 3 and 4 modules.

### Types of barcodes

#### Linear barcodes

| Symbology          | Cont/Disc  | Two/Many   | Uses                               |
|--------------------|------------|------------|------------------------------------|
| Plessey            | Continuous | Two        | Catalogs, store shelves, inventory |
| UPC                | Continuous | Many       | USA retail                         |
| EAN-UCC            | Continuous | Many       | Worldwide retail                   |
| Codabar            | Discrete   | Two        | Libraries, blood banks, airbills   |
| Interleaved 2 of 5 | Continuous | Two        | Wholesale                          |
| Code 39            | Discrete   | Two        | Various                            |
| Code 93            | Continuous | Many       | Various                            |
| Code 128           | Continuous | Many       | Various                            |
| Code 11            | Discrete   | Two        | Telephones                         |
| POSTNET            | Continuous | Tall/short | Post office                        |

#### 2-D barcodes

| Symbology   | Notes                                       |
|-------------|---|
| Aztec Code  | Public domain.                              |
| Codablock   | Stacked 1D barcodes.                        |
| Code 1      | Public domain.                              |
| Code 16K    | Based on 1D Code 128.                       |
| Code 49     | Stacked 1D barcodes from Intermec Corp.     |
| Data Glyphs | From Xerox PARC.                            |
| Data Matrix | From RVSI Acuity CiMatrix.                  |
| MaxiCode    | Used by United Parcel Service.              |
| PDF417      | The most common 2D barcode. Public domain.  |
| QR Code     | From Nippondenso ID Systems. Public domain. |