Braille, Its Types and Files

International Council on English Braille

James Bowden, Technology Committee

and

Clive Lansink, Code Maintenance Technical Committee

Version 0.9

December 2023

# Contents

[Contents 1](#_Toc153380121)

[1. Introduction 2](#_Toc153380122)

[2. What is Braille? 2](#_Toc153380123)

[3. Braille Characters 2](#_Toc153380124)

[4. Six and Eight Dot Braille 3](#_Toc153380125)

[5. Braille Character Encoding 3](#_Toc153380126)

[6. Unicode Braille 4](#_Toc153380127)

[7. Braille Fonts 5](#_Toc153380128)

[8. Braille Translation 5](#_Toc153380129)

[9. Braille for Documents 6](#_Toc153380130)

[9.1. Grade 1 or Uncontracted braille 6](#_Toc153380131)

[9.2. Grade 2 or Contracted braille 6](#_Toc153380132)

[9.3. Unified English Braille (UEB) 7](#_Toc153380133)

[10. Computer Braille 7](#_Toc153380134)

[11. Music 8](#_Toc153380135)

[12. Pre-Translated Braille Documents and File Formats 8](#_Toc153380136)

[12.1. BRF, BRL, BRA File Formats 8](#_Toc153380137)

[12.2. PEF Format 9](#_Toc153380138)

[12.3. eBraille Project (Under Development) 9](#_Toc153380139)

[13. Further Information 9](#_Toc153380140)

# 1. Introduction

This document aims to briefly describe the various types of braille and the basic digital file formats used for storing braille at the time of writing. Much more information about specific points raised in this document is available from many sources, some of which are listed at the end of this document.

# 2. What is Braille?

Braille is a tactile reading and writing system used by people with little or no sight. The system of raised dots as an alternative way to represent text that is read visually and was invented by the nineteenth-century Frenchman, Louis Braille, who lost his sight in early childhood. His touch reading system is still widely used today in many countries around the world.

Braille is most often either embossed onto paper or read on a refreshable braille display.

There are many devices that can produce braille on paper, ranging from simple frames (slates) through to complex electronic embossing machines (embossers). There are mechanical braille writing machines similar to typewriters, through to highly sophisticated computer-driven embossing machines used in braille production houses.

Refreshable braille displays and braille note takers are electronic devices, which have one or more rows of refreshable braille cells. A common design is that each cell consists of a series of plastic pins which can raise and lower to form the braille characters.

# 3. Braille Characters

A single braille character can be contained in a grid of dots, called a "cell", two columns wide by three or four rows high. Most often, braille embossed on paper uses two columns by three rows, while braille on refreshable braille displays often adds the fourth row.

The various braille characters are formed by using different combinations of these dots. For example, the letter a is the top left dot, ⠁ and the letter b is the top left dot and the one below ⠃.

For ease of reference, each dot in a cell is given a dot number, so all braille characters can be described by the dots that are used. Dot 1 is top left, with dots 2 and 3 below. Dot 4 is top right, with dots 5 and 6 below. When there are four rows, dot 7 is below dot 3 and dot 8 is below dot 6.

|  |  |
| --- | --- |
| 1 • | • 4 |
| 2 • | • 5 |
| 3 • | • 6 |
| 7 • | • 8 |

So in braille the letter a is described as dot 1 and letter b as dots 1 and 2.

Here is the alphabet in braille:

⠁ ⠃ ⠉ ⠙ ⠑ ⠋ ⠛ ⠓ ⠊ ⠚

a b c d e f g h i j

⠅ ⠇ ⠍ ⠝ ⠕ ⠏ ⠟ ⠗ ⠎ ⠞

k l m n o p q r s t

⠥ ⠧ ⠺ ⠭ ⠽ ⠵

u v w x y z

Capital letters and numbers may be shown in various ways, depending on the particular braille code being used. The most common sort of braille is 9. Braille for Documents, where the same braille signs are used for both upper and lowercase letters: uppercase is indicated by a special prefix called the capital sign; numbers also use letters a-j but with another prefix for numbers. For more details, see 9.1. Grade 1 or Uncontracted braille.

To be read correctly, it is important that the braille characters are the correct size, spaced correctly and that the dots are high enough and properly shaped for reading by touch. Each braille cell, including a space (no dots) occupies exactly the same amount of space. The dots forming a braille character are spaced uniformly within the braille cell, but there is normally a slight gap between adjacent cells and a larger gap between braille lines.

# 4. Six and Eight Dot Braille

Six dot braille is the main sort of braille used on paper and is the kind that most braille readers are taught. As described above, each braille character is a grid of two columns of three rows; different characters use different combinations of these six dots. With six dots, there are 63 different permutations of dots.

A fourth row of dots is commonly added on refreshable braille displays to make eight dot braille. This increases the number of permutations to 255. Typically, the bottom row (dots 7 and 8) are used for showing a cursor, for highlighting, and to show special characters or effects.

# 5. Braille Character Encoding

In order for a computer to communicate successfully with a braille embosser or refreshable braille display, and for braille to be stored in computer files for later use, there has to be an agreed way to represent the braille characters. The computer and the braille device must use the same encoding. For print, the computer industry has established encodings to allow common print text characters to be stored and communicated between computers and devices such as printers. By far the most common character encoding scheme for this purpose is ASCII.

Over time, a number of braille encoding schemes have developed that are based on ASCII. We have already explained that the braille typically found on paper uses six dot cells. There are 64 possible six-dot braille characters including the space character. These can easily be mapped to printable ASCII characters. Several mappings exist and among the most common are the North American Braille Computer Code (NABCC, also known as USA Computer Code), Euro Computer Code and French Computer Code. There are many others.

Typically, in these mappings, the ordinary braille letters a-z are mapped to the equivalent ASCII characters. Other ASCII characters are used to represent various different braille dot combinations, depending on which mapping is used. For example:

|  |  |  |  |
| --- | --- | --- | --- |
| Braille | US | Euro | French |
| ⠁ (dot 1) | a (97) | a (97) | a (97) |
| ⠡ (dot 1-6) | \* (42) | 1 (49) | 1 (49) |
| ⠌ (dots 3-4) | / (47) | | (124) | / (47) |
| ⠲ (dots 2-5-6) | 4 (52) | / (47) | . (46) |

The mapping between ASCII print and braille characters can be arbitrary, as long as the computer and braille device are using the same mapping. The mappings referred to here were developed at a time when it was common to transmit ASCII text between computers and other devices. If ASCII text is sent to a braille device using one of these mappings, the resulting braille is "readable". But as becomes clear when we discuss translation below, the resulting braille is not what a typical braille reader would expect to read.

The term ASCII Braille is sometimes used to refer to braille produced when printable ASCII characters are sent to a braille device using one of these mappings. A major limitation is that there are 95 printable ASCII characters (ASCII 32 to 126), but there are only 64 six dot braille characters. The North American Braille Computer Code deals with this by mapping the character ranges 96-126 and 64-94 to the same braille characters. The result is that upper and lower case letters cannot be distinguished. This is not a problem when an eight dot braille cell is used, which is often the case with a refreshable braille display, because the entire range of eight-bit characters from 0-255 can be mapped to the 256 possible braille characters.

# 6. Unicode Braille

A welcome development has been the Unicode braille patterns, U+2800-U+28ff, which uniquely map to the 256 possible eight-dot combinations. For example U+2801 is defined as braille dot 1. This recognises that braille characters exist and can be displayed in their own right, without thinking of them in terms of representing other print characters. In modern computers that are fully Unicode aware, these Unicode braille characters can be used to indicate braille characters in documents just like any other character (there are examples in this very document).

But Unicode braille is not yet widely used for storing braille in files and transmitting it to devices such as embossers. One reason is that these Unicode characters cannot be contained in single bytes that can just be transmitted reliably to a device. But any of the various ASCII encodings of braille will represent a single braille character by a single byte, and this works reliably with most of today's embossers, provided the same mapping is used. Later we discuss in more detail the common file formats for storing braille.

# 7. Braille Fonts

Braille fonts allow you to view braille characters on a computer screen, or printed in ink on paper. A braille font typically mirrors one of the standard braille encodings, such as the North American Braille Computer Code. For each character, the font produces a clear visual image of the braille dot pattern that corresponds to that character in the given encoding. If a braille font is not used, the characters used to convey the braille dot patterns will just display in their normal way. But if the appropriate braille font is used, a person who knows how to read braille by sight should be able to read those braille characters directly on a screen or when printed on paper.

Unicode characters are a special case because modern computers that have good support for the full set of Unicode characters should already be able to display the appropriate dot patterns for each braille Unicode character, without installing a braille font. It means sections of the document text that may include braille characters can be edited and manipulated at will, including being cut and pasted to other applications, and the braille characters should still display correctly.

**Note**: braille fonts do not "translate" print to braille: like any other font, they just show visually the dot patterns for each character known to the font.

There are two main kinds of braille fonts:

* Braille - which just shows the braille dots in a simple visual way.
* SimBraille - which shows the braille dots and "shadow dots" for vacant positions in the braille cell. The SimBraille fonts are particularly helpful to sighted people viewing braille on screen.

# 8. Braille Translation

So far, our discussion of braille encodings relates to the storing of arbitrary braille characters in files and transmitting braille to devices where it is basically readable. These encodings provide for a mapping between printable ASCII characters and braille characters. Now we turn our focus to a higher level, turning print text into the kind of braille a reader would expect to read. By print text, we mean the whole variety of printed material that can be found.

Although braille is a code and not a language, the process of converting print text to braille is called braille translation. The process of converting back from braille to print is often called back translation. Braille translation can be performed either manually or with automated tools, to make a braille version of a document. Braille translation can also occur dynamically (on-the-fly) controlled by a screen reading program when connected to a refreshable braille display. When braille translation is performed by a computer, the result is a series of braille characters as described above that is transmitted to a braille device to produce braille for the reader, or stored in a file for later use.

Braille translation is governed by a series of rules, sometimes called a braille table. These rules are usually developed by braille authorities that cover different languages in different countries and regions. They specify how printed text is to be converted into the braille that a reader would expect to read, but without regard for how that braille is actually conveyed to the reader. When these rules are applied, there is generally no one to one relationship between print and braille characters. Sometimes a character in print translates to two or even more braille characters, and sometimes a whole printed word translates to a single braille character.

# 9. Braille for Documents

Braille can be used for all kinds of documents such as ordinary literary text found in books and magazines, textbooks, technical manuals, and other materials. It is nearly always a six dot code and is generally the kind of braille that is taught to people when learning. Sometimes the rules can be complex.

## 9.1. Grade 1 or Uncontracted braille

Grade 1, or uncontracted braille, represents each letter by a single braille character. Every letter of each word is written out, much as print. Other braille characters are used for punctuation marks and other special symbols. For example, the word "something" is ⠎⠕⠍⠑⠞⠓⠊⠝⠛.

With only 63 possible dot combinations, braille generally does not have unique characters for upper and lowercase letters, or numbers. Instead, prefix characters are used to show the next character is uppercase or a number. The prefixes, and the rules governing them, may vary from language to language, but the same general concept is often used. For example, in English braille:

|  |  |
| --- | --- |
| Print | Braille |
| a | ⠁ (dot 1) |
| A | ⠠⠁ (dot 6 1) |
| 1 | ⠼⠁ (dots 3-4-5-6 1) |
| 11 | ⠼⠁⠁ (dots 3-4-5-6 1 1) |
| 1A | ⠼⠁⠠⠁ (dots 3-4-5-6 1 6 1) |
| 1A1 | ⠼⠁⠠⠁⠼⠁ (dots 3-4-5-6 1 6 1 3-4-5-6 1) |

Note that some languages do not show capital letters in braille.

Grade 1 braille is the kind of braille taught to new braille learners. It is also the kind of braille used often in braille signage and in other public places, to make it readable to the maximum number of people.

## 9.2. Grade 2 or Contracted braille

Several countries (by no means all) have a grade 2 or contracted braille code. This adds a series of braille symbols to represent common words or groups of letters. Thus, the overall size of a braille text is reduced and a fluent braille reader will consequently gain a corresponding increase to their reading speed.

In English braille, there are 180 such contractions, reducing the volume of general text by about 20%. Examples of contractions used in English braille include the letters ED, ER, ING and TH; and the words AND, FOR, IT, THE and WITH.

A number of contractions consist of two or more braille cells. For example, the contraction for the word "some" consists of a prefix dot 5 followed by the letter S, ⠐⠎. The word "something" in grade 2 English braille is ⠐⠎⠹⠬.

The rules for grade 2 braille are often complex and take time to learn, but grade 2 is the main kind of braille used for most novels and other documents.

Different languages have different contractions. For example, in German, there are contractions for letter combinations such as EI and SCH, and words such as BEI and DAS.

## 9.3. Unified English Braille (UEB)

In the past, there were subtle differences in the way braille contractions were used in different English-speaking countries. There were more major differences in the way mathematical and other technical notation was shown in braille.

In 1991, the International Council on English Braille (ICEB) was formed with a charge to establish a single braille code which would incorporate all subject areas (except music) into a single code. The project was declared sufficiently complete in 2004 and has now been adopted as the official braille code in all ICEB member countries: Australia, Canada, Ireland, New Zealand, South Africa, UK and USA.

The unification of the English braille codes into UEB not only facilitates sharing material between countries, but also covers many more print symbols which were not available in older braille codes.

UEB not only encompasses ordinary literary text but also incorporates symbols for mathematical and other technical subjects, all in the one code. Previously, this was often done by a separate braille code.

# 10. Computer Braille

Computer braille is a similar concept to ASCII braille mentioned earlier, and may often be the same. As discussed above in ASCII braille, computer braille is a one-to-one mapping of print characters to eight dot braille characters. It is generally used on refreshable braille displays and was most often used in computing or computer programming contexts.

Originally used as a simple system for showing the characters on a computer screen, computer braille can represent all the characters available on a standard computer keyboard. It can actually represent all the characters of the 8-bit (ANSI) character set. Being a simple system, it did not require much computer resource to implement, particularly in earlier days where computer memory was limited.

Typically, the lower row of dots (dots 7 and 8) is often used to show capital letters and special characters, or for showing a cursor or for highlighting.

You might ask why we have listed computer braille under translation when it is a one to one mapping similar to those described in the section on braille character encoding as there appears to be no additional translation involved.

The answer is that the one to one mapping between print and braille characters fails when computer braille needs to be rendered using six dot cells. The one-to-one mapping generally still holds for many characters, but those characters which were using dots 7 or 8 need special treatment. Most often a system of prefixes is employed to show either an alternative or special character. For example, in computer braille using eight dot cells, the capital letter A is represented by braille dots 1 and 7 ⡁. Dot 7 is not available when using six dot cells, so a capital prefix dot 6 is placed before an ordinary lowercase a, giving ⠠⠁. Certain other characters also use two or more braille cells.

# 11. Music

The braille music code redefines the meanings of the 63 six dot braille characters to have musical meanings. The music code was invented by Louis Braille, alongside the code for literary material.

Unlike print staff notation, the braille music code shows all the musical elements in a single line, including note pitches and durations, together with all the accidentals, expression marks, ornaments and fingering, nuances and other instructions present in the print.

The braille music code is the only braille code which is basically the same around the world.

# 12. Pre-Translated Braille Documents and File Formats

A braille document is a computer file which has braille characters in it, instead of print characters. Such a file may be said to be pre-translated, as generally, it has been generated by translating a print document into braille. The translated braille characters are stored in the file and no further translation is required when that file is sent to a braille device.

The advantage of a pre-translated file is that the braille is generally very high quality and multiple braille codes or special requirements can be catered for. Although some braille embossers and displays have their own braille translation built in, it is much easier to keep braille translation software up to date when it runs on a computer. The layout of the braille can also be precisely controlled and guaranteed, especially important for tables and other laid-out information.

## 12.1. BRF, BRL, BRA File Formats

The BRF, BRL and BRA file types are all based on storing braille characters in ASCII braille, according to a particular country encoding.

Generally speaking, BRF files consist of pre-translated, pre-formatted pages of braille, ready to be embossed on a particular paper size. They can also be read directly on a refreshable braille display with no further translation.

BRF files are the analogous of plain text files, except the printable characters represent braille characters in ASCII braille. The only other characters found in a BRF file are space, carriage return/line feed and form feed. These files can be embossed by printing or copying them directly to a braille embosser. Each line, ending in carriage return/line feed, is embossed in turn from the top of the page. Space characters are used to position the braille characters as needed in each line.

The BRL file is a variation of BRF, the main difference being that lines may not be wrapped to a particular line width for embossing. This distinction is not always the case and sometimes BRF and BRL can be synonymous.

The BRA file is generally used in Spanish-speaking countries and is exactly the same as a BRF file except that the Spanish ASCII braille table is used.

## 12.2. PEF Format

The Portable Embosser Format (PEF) file is an XML based braille file, again containing pre-translated, pre-formatted pages of braille, ready to be embossed. Special software is needed to interpret the XML.

Unicode braille characters are used to represent the braille, avoiding the problems of multiple different versions of ASCII braille.

A header section in the XML is used to declare various metadata associated with the document, such as the size of the braille pages.

PEF has not been adopted in all countries.

## 12.3. eBraille Project (Under Development)

A new electronic braille file format is currently under development and seeks to address many of the limitations of having a purely text-based braille file format (such as BRF). The main problems that have been identified are:

* there is no document structure (such as headings, paragraphs, bulleted lists etc - all such information is inferred by the human reader by interpreting the spatial layout of the braille;
* different countries use different versions of ASCII braille, preventing effective international sharing of braille;
* the pre-formatted files are set for a particular page size, limiting use if a different size is required;
* there is no possibility to include graphics along with the text.

Development is ongoing and the new format promises all kinds of future benefits to braille readers.

# 13. Further Information

There are many further documents, articles and internet sites related to braille and this document has only scratched the surface. Below is a selection of internet pages where more information can be found:

Definition of braille:

<https://en.wikipedia.org/wiki/Braille>

Braille Articles and factsheets from the Braille Authority of North America (BANA):

<https://www.brailleauthority.org/bana-position-statements-and-fact-sheets>

Braille size and spacing:

<https://www.brailleauthority.org/size-and-spacing-braille-characters>

North American Braille Computer Code chart:

<https://brltty.app/doc/Manual-BRLTTY/English/BRLTTY-14.html>

Rules of Unified English Braille:

<https://iceb.org/ueb.html>

World Braille Usage:

<https://www.perkins.org/resource/world-braille-usage/>

eBraille Project:

<https://daisy.org/activities/projects/ebraille/>

International Council on English Braille:

[www.iceb.org](http://www.iceb.org)