Implementing braille printing in labelling & packaging with Xaar's Versatex printbar

Suzy Sparke | Mark Crankshaw

High Laydown TECHNOLOGY

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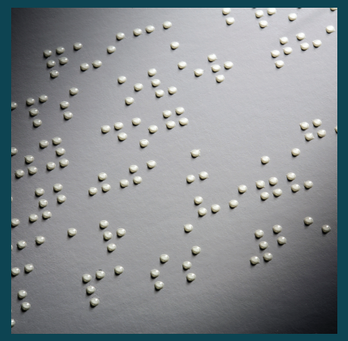
Introduction

Braille on medical packaging is a critical accessibility feature that enables blind and visually impaired individuals to independently identify products

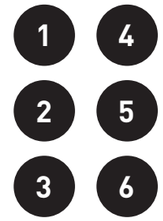
Regulatory requirements, particularly in the European Union, mandate Braille labelling on pharmaceutical packaging. In addition, draft regulation in Spain is proposing the mandatory use of Braille on packaged consumer products, such as: Food items (e.g., meats, milk, canned goods) and Hazardous products (e.g., detergents, fertilisers, lighters). It is likely that European Union legislation will follow this. In the USA there is also increasing demand for Braille printing but this is voluntary and not mandated.

However, Braille dot specifications are not regulated, they are recommended by certain ISO Standards. Traditionally, Braille is embossed onto cartons using embossing tooling, but advances in digital printing, such as Xaar's Versatex printbar with high-build capabilities, offer new ways to add Braille without physical embossing. This also leads to the possibility of variable data Braille, for example allowing patient specific information to be printed on medicines.



What is braillie and how is it used?

Braille is a tactile writing system of raised dots used by people who are blind or have low vision. Braille characters are formed within units called cells, each cell comprising six dot positions arranged in two columns and three rows (a 3×2 matrix). Different combinations of raised dots represent letters, numbers, punctuation or even whole words. Each dot position in the cell is assigned a number from 1 through 6: positions 1-2-3 are the top-to-bottom dots in the left column, and 4-5-6 are top-to-bottom in the right column.



Braille is not a language itself, but a code similar to morse code; it can render any language by mapping its characters or phonetics into tactile form.

People read Braille by gently moving their fingertips across the patterns of raised dots. In doing so, they rely on consistent dot quality (sufficient height, equal shape) and standardized spacing to recognize each character by touch. A standard Braille dot feels like a small spot of about 1.5 mm in base diameter and typically around 200 microns in height on paper. Multiple dots in a cell are 2.5 mm apart from each other (center-to-center), cells are spaced about 6 mm apart, and lines of Braille are spaced about 10 mm apart. These dimensions are known as the Marburg Medium standard, have been found to be optimal for tactile reading. Producing readable Braille on packaging is about consistency and quality.

Grades and why Grade 1 is used on packaging?

Grade 1 (uncontracted) represents each letter or symbol cell by cell and is preferred on medicine packaging to avoid ambiguity.

Grade 2 (contracted) shortens common words and groups, improving space efficiency but requiring advanced literacy—unsuitable for critical labels.

Grade 3 is personal shorthand and not used in regulated materials. For Xaar's research, we will only be referring to Grade 1 (uncontracted) Braille.

Standards & regulations for pharmaceutical packaging

(ISO 17351, MARBURG MEDIUM, ONCE SPAIN, RNIB)

Legal mandates
The most prominent regulation is the European Union's directive in 2004 (amending Directive 2001/83/EC) which required that the name of the medicinal product (and often its strength) be provided in Braille on the outer packaging. This legal requirement took effect for all new medicines seeking marketing authorization in the EU from October 2005 onward, and by 2010 all existing authorized medicines also have to comply. In practice, this means any pharmaceutical company marketing in the EU must include Braille on their product's outer carton for identification.

In the EU Braille is mandated on medicinal packaging, but the specifications of the Braille are only recommended. The MHRA states that best practice is for Pharmaceutical packaging companies to be compliant with ISO 17351 dot-height targets (200 microns high; ≥95% ≥160microns high) and Marburg Medium spacing, with documented in-process and release QC (e.g., dot-height sampling and vision verification). Pharmaceutical packaging companies treat these recommendations as regulations.

Technical Standards
The key international standard is ISO 17351:2013 "Packaging – Braille on packaging for medicinal products." This standard (developed from an earlier European standard EN 15823:2010) specifies the dimensions and quality requirements for Braille on medicine packs. According to ISO 17351, the target height for Braille dots on pharmaceutical packaging is 200 microns high, and no more than 5% of the dots should be lower than 160 microns. The ISO standard's height criteria are effectively treating 160 microns as a minimum and 200 microns as an optimum target for Braille dot quality/ readability.

In terms of spacing and layout, the ISO standard highly recommends the "Marburg Medium" Braille font spacing convention. Marburg Medium is a standardized set of Braille dimensions originally defined in Germany and endorsed by the European Blind Union.

Its key specifications (also mirrored in the U.S. Pharmacopeia guidelines and other standards) are dot base diameter between 1.3 mm and 1.6 mm, dot-to-dot spacing of 2.5 mm within a cell (both horizontal and vertical), cell-to-cell spacing of 6.0 mm horizontally, and line-to-line spacing of 10.0 mm. These values have a tolerance of about plus and minus 0.1 mm in practice.

Marburg Medium does not itself fix a dot height, focusing mainly on lateral dimensions; it assumes the dot height will be whatever the relevant standard (ISO 17351 or national guidelines) calls for. In Europe, the combination is that Marburg Medium spacing is the expected standard for pharma packaging. The European Commission's guidance on labelling explicitly advises using Marburg Medium format for consistency across products.

The presence of Braille text on the package (for product name etc.) is a legal requirement in the EU, whereas the exact technical specs (dot size, spacing) are provided by standards like ISO 17351 which are highly recommended. Regulators expect companies to follow these standards. Failing to meet the dot height or spacing recommendations could be deemed a labeling defect so the ISO/Marburg specifications are treated almost as mandatory.

Methods for creating braille on packaging

Producing Braille on packaging can be done via several methods, each with its own considerations in a production environment:

Embossing (Mechanical Braille)

- The most common traditional method is embossing the Braille into the carton board.
- This is achieved with die set that punches Braille dots into the material creating a rounded bump on the outside face.
- Embossing has the advantage of producing very crisp, durable dots with precise height (the die's depth defines the dot height, often 200 microns).
- It doesn't add any ink or material to the package – it only reshapes the substrate. For every new product or a change in text or carton size, new tooling is needed.
- Small production runs or frequent design changes become inefficient.

Screen Printing (UV Varnish)

- Braille is screen printed as a thick UV-curable varnish (clear ink) through a stencil that has Braille dot patterns, directly onto the packaging material.
- Multiple layers or a special high-build screen can achieve dots of the required height.
- Once cured (hardened), the varnish forms solid bumps.
- Used when Braille is needed on materials that cannot be embossed, like rigid plastics or already-formed components.
- Screen printing can be slow and messy compared to embossing
- Achieving consistent dot height requires precise control and often multiple layers of ink.
- Screens wear out with use resulting in reduced sharpness of edges build height and dragging.

Integrally Molded Braille

- Braille can be molded into part of the container itself, especially for plastic packaging.
- For example, a plastic bottle might be molded with Braille on its surface alongside a warning triangle, or a blister pack might have Braille formed in the plastic.

Braille Labels

- Print or emboss Braille on a separate adhesive label that is then applied to the package

Digital Inkjet Printing of Braille

- This is similar to Screen Print UV varnish but jetting the varnish through inkjet printheads.
- There is no setup cost so removes the cost of dies or screens and the problems of screen wear keeping consistent and repeatable quality through out a production run
- Using High viscosity fluids and High Laydown technology dots of up to 250 microns can be produced
- Digital flexibility instant changeover between jobs, and the ability to print variable Braille.
- Can be integrated into existing digital printing lines or used as a standalone unit on a production line

Justification for Developing a Braille print mode on the Xaar Versatex

- Xaar has developed the Versatex printbar and see potential in using this as a Braille printer. It has higher quality, higher reliability than other technologies and has unique capabilities such as variable data.
- The challenge for inkjet is achieving the height and shape requirements. Inkjet droplets naturally want to spread out on the substrate, potentially making a dot too flat or too wide. It requires careful control of the ink's consistency, the droplet size, how drops merge, and immediate curing to keep the dot in a tall shape.
- The research by our team focuses on optimising these parameters to meet the Braille standards using Xaar printbars.

Experimental insights: Printing braille with Xaar inkjet technology

A series of trials were undertaken to determine how to consistently achieve Braille-standard dots using Xaar's Versatex printbar. The experiments explored variables such as substrate type, surface treatment (corona), drop deposition, ink curing, and printing speed. The goal was to meet the ISO 17351 target (≥200 micron dot height, dot diameter 1.4–1.6 mm) and ensure the printed Braille is readable to users.

Below is a summary of the key findings for each factor:

Substrate and Surface Energy
The material on which Braille is printed has a major impact on dot height and shape. We tested:

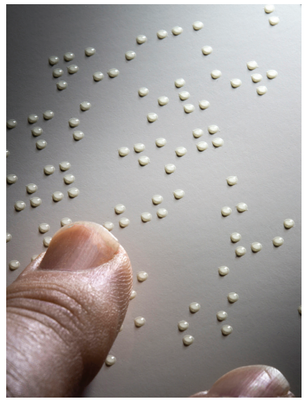
- Paper label stock (BZY Raflabrite, a white glassine-backed paper commonly used for labels)
- Polypropylene film (PP)
- Polyethylene film (PE)

The results revealed significant differences in dot formation. Using identical print settings, the PP substrate yielded the tallest dots – about 200 micron height at 19 m/min line speed without any surface pre-treatment. By contrast, the paper (BZY) achieved 190-micron height and with a corona treatment applied.

Corona treatment is a surface treatment that typically increases surface energy (improving ink wetting control), and in the BZY trial we used a corona dosage level of 85 (W.min/m2) to help the ink form a nice dome; this combination was considered the "best result" on that material and it earned a high readability score in a blind/ visually impaired user trial (more on that soon).

The untreated PE was initially the worst: it only reached about 163 microns height under the same conditions. PE has lower surface energy and ink tended to spread more, resulting in flatter, wider dots. However, when we applied corona treatment to the PE, its performance improved dramatically – with sufficient corona, PE could achieve dot heights comparable to optimized PP.

Higher surface energy and less absorbent surface leads to taller dots, because the ink doesn't spread out as much and can build upward. PP inherently provided that (likely due to a receptive surface coating or its chemistry), whereas PE needed surface activation to get similar wetting behavior. Paper (BZY) was intermediate; it is somewhat porous and absorbent, which can limit height, but the coating and corona helped.



Substrate choice and preparation are critical: if using an inherently good substrate like a certain PP label stock, one might achieve Braille specification more easily. If using a challenging material, surface treatment (corona or primer) can "equalize" it to perform nearly as well as the best substrate. In all cases the dot diameter and height have an inverse relationship given the same drop volume: when height was lower, the dot spread wider (and vice versa). This was observed as a quick diagnostic – for identical print settings, if one substrate showed a shorter dot, it invariably had a larger base diameter, indicating more lateral spread. Therefore, measuring dot diameter can indirectly signal if height is likely on target: a very large dot (exceeding 1.6 mm) suggests it's too flat.

Drop Pinning (UV Pre-Cure)
Immediately after each Braille dot is printed, it is given a low dose of UV light to "pin" it (surface cure) before it can spread. Running the pinning at full power gave the cleanest, tallest dots. Reducing the pinning made dots wider and flatter.

Varnish temperature
Cooler varnish has a higher viscosity and might stop dots spreading as quickly, making them taller. The temperature was reduced from 38°C to <30°C and the settings adjusted so the same amount of ink was laid down.

Result: dot height and width were unchanged.

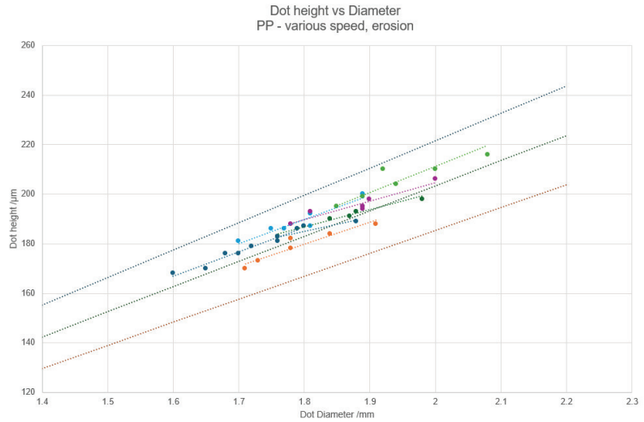
Print speed
Testing was conducted between the speeds of 19 to 30+ m/min.

Where the amount of laydown stayed the same at different, dot height stayed about the same (e.g., 200 microns on PP at 19).

At higher speeds the amount of laydown inherently reduces. For example at 30 m/min there was a smaller drop size which we could offset to a limited degree. By the time the dot reaches the final UV pinning lamp, it has done most of its spreading, so small speed changes don't change the final shape. In practice, run at normal production speeds (15–30 m/min) and focus on ink volume and strong UV pinning, not speed. However at 30m/min 200 microns was not achieved although the Braille was readable.

Dot pattern (Screening)
Different screening patterns were used to place the drops for each Braille dot—tighter clusters, different sequences. In addition the ink volume split for the dot between two printhead banks was varied.

There were negligible changes. Putting down the same total amount of ink and curing it quickly, results in a dot with the same height and width.



The project established that Xaar's Versatex printbar can achieve the Braille specification under optimized conditions. Braille dots reaching 200 µm in height were printed at production-relevant speeds. At ~170 microns height (slightly below target), the measured the dot diameter was approximately 1.6 mm, which is at the upper end of the allowed range. This confirms the inverse height/width relationship and matches the Marburg specification limits. When 190–200 microns build height was achieved, the dot diameters are larger but were preferred when tested by Braille readers.

These outcomes were achieved on polypropylene-based substrate with no corona (200 microns at 19 m/min) and on coated paper with corona (190 microns at 20 m/min). In both cases, dot spacing and arrangement followed the standard Marburg dimensions, and sample prints were evaluated by visually impaired users.

A reading trial with participants from Suffolk Sight (a visual impairment organization) was conducted using the BZY paper samples. The readers were asked to read Braille labels printed by this process and provide feedback. The sample with ~190 µm dot height on BZY (which included six panograms) received a "high readability" score from users, indicating they could comfortably and accurately read the Braille. This g validated that printed Braille, if produced to the right dimensions, is functionally as legible as traditional embossed Braille to end users. The readers emphasized consistency – all dots feeling the same and properly spaced – as a key factor in readability. They could tell if a dot was slightly lower or irregular, which could slow them down. Therefore, ensuring uniform dot quality across the entire text (not just one dot's height in isolation) was vital.

Conclusion

Braille printing via the Xaar Versatex printbar represents a significant step in making packaging more agile while maintaining accessibility. The demand for Braille packaging is being driven by legislation in Europe particularly within the pharmaceutical industry.

It exemplifies how thoughtful application of technology can uphold the principle voiced by Stevie Wonder's quote: "We need to make every single thing accessible to every single person with a disability."

By rigorously following best practices like those outlined in this paper, the industry can ensure that Braille on medicine packs remains not just an obligatory feature, but a reliably readable and user-friendly aid for people who depend on it. The convergence of regulatory compliance, materials science, and cutting-edge printing technology in this domain ultimately serves a human-centered goal – empowering visually impaired individuals with the information they need for safe and independent use of medications or simply the use of FMCG products.

Braille printing with Xaar inkjet technology has proven to be a viable and innovative solution for adding accessible information to pharmaceutical and FMCG packaging. It combines the flexibility of digital printing with the precise requirements of Braille production – enabling on-demand Braille without the need for custom tooling. Xaar's research underscore that success in this endeavor hinges on understanding both the regulatory landscape and the material science behind a tactile dot. One must carefully balance factors of substrate choice, ink behavior, and curing technique to meet the established standards (ISO 17351, Marburg Medium) that ensure Braille is universally legible.

For pharmaceutical, FMCG companies, and packaging providers, adopting inkjet Braille offers several benefits: reduced lead times for new products (since Braille can be printed from digital files rather than waiting for embossing dies), easy changes for different languages or product variations, and the ability to incorporate Braille into a digital printing workflow alongside other variable data. These advantages come without compromising quality or compliance, as long as the process is well-controlled. In fact, with proper calibration, digital printing can offer greater consistency dot-to-dot and box-to-box, potentially improving overall quality assurance for Braille. This research has demonstrated Braille dots printed with Xaar technology that meet the 200 microns height target and received positive reviews from Braille-reading individuals.

References

- European Directive 2004/27/EC (Article 56a) – Braille on medicinal product packaging
- ISO 17351:2013 – Braille on packaging for medicinal products (specifications for dot height and quality)
- Marburg Medium Braille standard – spacing and dimensions recommended for pharmaceutical packs
- Pharma Braille Guidelines – Best practices for pharmaceutical Braille (Grade 1 usage, no contractions)
- Internal Xaar Braille Printing Research – Mark's Judkins's team data on drop parameters, substrate effects, and outcomes
- Packaging Digest, "Braille on Pharma Packaging" – Industry context on Braille mandates and quality control (Troika BrailleCAM, etc.)
- Braille Works & Wikipedia – General Braille definitions and education (Braille cell structure, Grade 1/2/3 definitions)https://en.wikipedia.org/wiki/Braille
- Foundation for Blind Children interview – Insights on Braille reading and tracking skills.

Appendix 1 - Abbreviations

Abbrev.	Meaning	Context in this paper
PP	Polypropylene	Substrate that achieved ~200 µm dot height without corona
PE	Polyethylene	Needed corona to reach target dot height
BZY	Raflabrite BZY (label stock)	Coated paper label used in trials (~190 µm with corona)
UV	Ultraviolet	Pinning/curing of the printed dots
HL	High Laydown	Xaar mode for depositing high fluid volumes per dot
UHV	Ultra High Viscosity	Xaar capability for jetting very viscous fluids
MHRA	Medicines and Healthcare products Regulatory Agency (UK)	Oversees UK packaging compliance/label changes
ISO	International Organization for Standardization	Publisher of ISO 17351 Braille packaging standard
EU	European Union	Region mandating Braille on outer packs
GMP	Good Manufacturing Practice	Quality framework; inspectors check packaging compliance
QC	Quality Control	In-process/release checks (height, presence, alignment)
FMCG	Fast-Moving Consumer Goods	Non-pharma packs also targeted by this approach
mm	Millimetre	Spacing metrics (2.5 mm, 6.0 mm, 10.0 mm)
m/min	Meters per minute	Line speed during trials (e.g., 19–22 m/min)

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