



Overview of HP LaserJet Pro monochrome printing technology

How HP Resolution Enhancement technology delivers unsurpassed print quality

Make an impression with HP LaserJet Pro printers

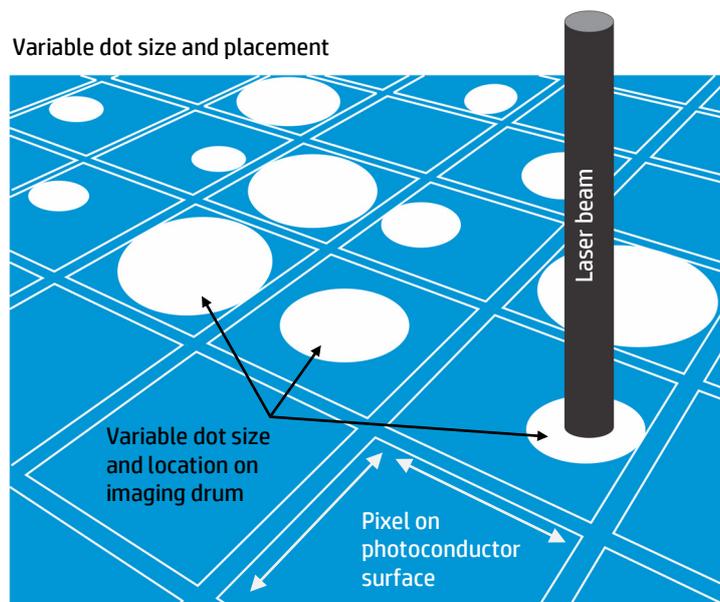
Print quality has become increasingly important. Businesses produce documents to help them stand out and portray a professional appearance for customers and other external audiences. Of particular importance is the quality of documents, often developed to support sales and generate revenue. Consumers have also become more discriminating in their expectations. No longer is the specification of physical dots per inch (dpi), also known as optical, or spatial dpi resolution, adequate as the sole indicator of print quality. To deliver high-quality results, HP has developed a collection of innovative technologies collectively known as HP Resolution Enhancement technology.

This paper discusses these innovations and describes how HP LaserJet Pro monochrome printers achieve superior print quality.

Variable dot size and variable dot placement

HP uses sophisticated laser scanning assemblies and industry-leading laser modulation control to vary the size and position of each laser exposure within each pixel on the addressable printer grid. This combination enables spectacular detail and reproduction fidelity. HP's variable dot placement allows printed dots to be positioned in locations other than the centre of each pixel on the printer grid. Very small printer dots can be placed near pixel edges to achieve fine-line detail and images with crisp, smooth edges and improved print quality.

Variable dot size and placement

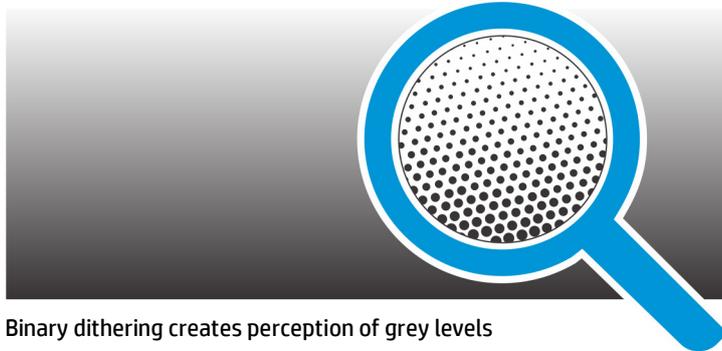


Single vs. multi-level printing

Single-level printing

Single level (or binary) printers use a binary printing process that cannot vary the amount of toner applied to a pixel. Each pixel receives either no toner (0) or a full pixel (1) level of toner. In binary printing, intermediate tone levels or shades at a single dot location are not possible, so in order to produce the appearance of grey levels in an image, binary printers rely on a process known as dithering. Dithering creates the perception of grey levels by grouping binary dots into a region called a halftone cell. Individual binary dots are so small, they visually blend within a halftone cell creating the appearance of intermediate tone levels between white and black.

The downside of dithering is this grouping of individual dots effectively lowers the dpi resolution. Prints can appear grainy, with rough tonal gradations, visible dot structures, and reduced edge sharpness.



Binary dithering creates perception of grey levels

Multi-level printing

Multi-level printers can vary the amount of toner within a single dot to produce intermediate tones between black and white and are less reliant on dithering. Multi-level printing can produce prints that are less grainy and have smoother tonal gradations than binary prints.

Desired appearance	White	Very light grey	Light grey	Dark grey	100% black		
Binary halftone cells, 2 x 2 dots							Binary printers require grouping of multiple dots and use dithering to create the appearance of tone levels, with reduced effective resolution
HP multi-level single dot pixels							HP multi-level printing can vary the amount of toner within a single dot, creating exact shades with high effective resolution

HP multiple resolution

HP LaserJet Pro monochrome printers offer multiple resolution settings to accommodate a variety of printing needs. For example:

HP FastRes1200 is 600 x 600 dpi using multi-level printing combined with HP variable dot size and variable dot placement technology. This can yield prints similar to or better than traditional 1200 dpi printers. FastRes 1200 is the default setting and provides outstanding print quality for most document types.

HP ProRes is 1200 x 1200 dpi binary printing, and is best suited for documents having fine lines and detail, like mechanical drawings or other highly detailed documents. HP ProRes is an optional setting and can be activated via the print driver.

Adaptive halftoning

Adaptive halftoning is an HP-patented, image-enhancement feature that helps to smooth edges of text and graphics while maintaining the quality of area fills. One of the difficulties of digital printing is to produce smooth tonal areas at the same time as clean and sharp edges. Adaptive halftoning provides a solution to this problem.

Smooth areas with constant tones are optimised by selecting low-frequency digital halftones, which have larger spacing between halftone cells, and reproduce image areas of low detail with improved smoothness. The tone level is built up by turning on and off dots while using multi-level printing, as described earlier in this paper. At a normal viewing distance, your eye blends the dots together so the tone looks smooth. Using low-frequency halftones creates smoother, more accurate tones in large areas of the same tone, such as in large text, bar charts, etc.

While the eye blends the dots in smooth areas, it is also very good at discriminating minor variations at edges. Edge sharpness is optimised by selecting high-frequency digital halftones, which have smaller spacing between halftone cells and better reproduce fine detail and eliminate jagged edges. Adaptive halftoning provides a solution to the requirement for smooth tones and sharp, crisp edges by locating and increasing the digital halftone frequency at edges. This HP-patented technology is implemented in specialised electronics to provide fast printing performance.

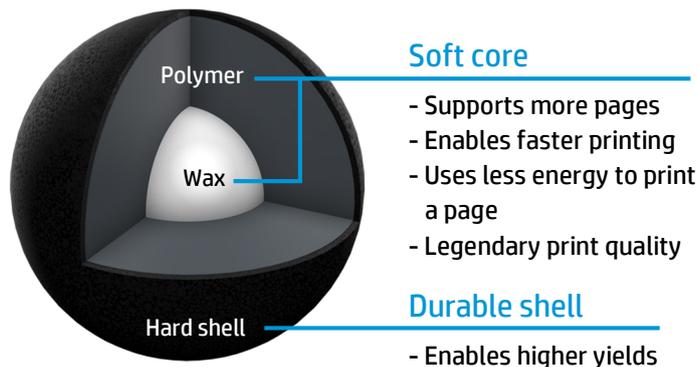


12 point text without adaptive halftoning

12 point text with adaptive halftoning

Original HP Toner Cartridges with JetIntelligence

The latest HP LaserJet printers are built around a breakthrough in toner chemistry using the new Original HP Toner cartridges with JetIntelligence. The spherical shape of the precision black toner provides more control in transferring toner to the page, which produces sharp text, bold blacks, and crisp graphics. The soft core facilitates quicker melting and a smooth flow onto the page, while the durable, hard shell reduces toner particle wear and maintains toner shape and size from the first printed page to the last.



Conclusion: HP printers deliver superior print quality

HP LaserJet Pro monochrome printers employ multiple innovative technologies integrated into a complete printing system. The result is maximised ease of use and high-quality output with exceptional image detail, crisp text, and ultra-smooth tonal gradations. With these built-in image enhancement technologies, HP LaserJet Pro devices consistently provide the best print quality, automatically and right out of the box.

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