What is Inline Digital Printing?

Of the many words that describe the challenges of package manufacturing, one is especially fitting. That word is complexity.

Advances in transportation, information technology, automation, and other industries have enabled manufacturers to offer more products to more consumers than ever before. With increased opportunity, however, comes increased complexity. Sources of this complexity include:

Retail convergence—distinctions between retailer genres, such as drugstores and supermarkets, are disappearing. Many stores now carry all types of daily needs products.

Size segmentation—retailers increasingly identify themselves by package size. Some specialize in the very convenient (single-serve items); others specialize in the very economical (family sizes and bulk quantities).

Brand growth—retailers now compete in many consumer goods markets with their own private brands.

Product fragmentation—in an effort to distinguish themselves from private brands, name-brand makers of coffee, beer, anti-perspirant, and many other items have expanded from a few basic varieties to a long menu of flavors, intensities, and scents.

Health awareness—consumers research ingredients and make buying decisions based on this research. Presence of certain ingredients can make or break a sale.

For manufacturers, much of the burden of competing in this new marketplace falls onto packaging. Packaging must meet different specifications for each retailer, accommodate wide ranges of sizes and quantities, and convey all manner of information about product type and ingredient content.

Conventional printing can struggle to cope with these trends. Traditional presses are “high momentum” technologies: once set-up is complete, they can replicate one design quickly and reliably for hours on end. What they cannot do easily is adjust—and new retail, with its myriad of retailer specs, varieties, and ingredient changes, demands agility.

As a result, digital printing technologies are becoming more widespread. These technologies are designed to be more agile without compromising speed, quality, reliability, or endurance. Inline Digital Printing is one of these technologies.

Inline Digital Printing (IDP) is a new printing method that combines two technologies: laser-reactive materials and multi-laser arrays. Laser-reactive materials are specialized coatings that change color in areas exposed to laser light. The multi-laser array is a specially-designed print head that forms images on laser-reactive materials.

Used together in the inline digital method, these two technologies are addressing the current challenges of package printing:

Speed—current IDP solutions can print monochrome images at up to 1 m/s or 197 ft/min.

Quality—current IDP solutions can achieve resolutions of 300 dpi.

Reliability and Endurance—IDP is a clean, dry process and is more manageable than processes dependent on inks, powders, or waxes. Lasers are one of the most long-lasting, consistent marking technologies.

This whitepaper endeavors to explain how this technology works and how it will change package printing for the better.
Core Technologies
IDP is a combined application of new proprietary chemical and advanced optical technologies.

Chemical Technology
IDP uses a laser-reactive coating to create images. This coating is applied to a substrate as part of the packaging. The coating is white or colorless and, when irradiated with a laser, undergoes a chemical reaction and turns black (or another color as determined by the coating formulation).

Process steps are as follows:

1) **Substrate and Coating Matching:** the converter selects a laser-reactive coating suitable for the target substrate. Possible substrates include plastic film, paper, and corrugate.

2) **Coating Application:** the converter applies the coating to the substrate using a standard flexographic, gravure, screen, or other print process.

3) **Finishing:** the coating dries or is cured. It is now ready for imaging at the converter, on a filling line, or at a retailer.

Optical Technology
IDP uses a multi-laser array to create images. Objects coated with laser-reactive material pass beneath the array and turn black (or another color) in areas exposed to the laser beam.

By selectively pulsing the lasers on and off, the array can choose which areas change color and which areas remain white/colorless. The combination of colored areas and whitespace form a monochrome image.
Printing: An Example

This example shows how food manufacturers can print secondary packaging on the filling line using the IDP method.

The carton arrives at the manufacturing site pre-coated with laser-reactive material. The coating is already dry and ready for handling. The manufacturer fills the carton with product and seals for shipment.

The laser array irradiates the sealed box as it moves along the line at up to 1 m/s (197 ft/min).

Each laser within the array pulses on and off precisely, selecting which areas will remain blank and which areas will change color. The combination of colored and blank areas forms a 300 dpi monochrome image.

The retailer receives a high-resolution print that is easy to read and scan, shows up-to-date product information, and resists smudging and scuffing.
Supply Chain Position

IDP can be placed at any of several points in the packaging supply chain.

**On converting lines**, IDP is a high-speed, flexible alternative to conventional printing. It can print product information on labels, sleeves, and folding cartons in place of flexographic or gravure processes—either inline or off-line.

**On filling lines**, IDP can add product information to “blank” containers after filling or packing. Graphics and text can be adjusted quickly, minimizing the impact on the supply chain when graphics, ingredients, or market conditions change.

**At retailers**, IDP can add time-sensitive content immediately before products go on sale. For example, packages can display the outcome of a recent sporting event or information about a short-term contest.

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**At the converter:**
Position in line with slitters, coaters, bottle molding lines, etc. to print variable information efficiently.

**At the point of fill:**
Print product names, ingredients, machine-readable codes, and other information after filling containers and cartons.

**At the retailer:**
Add time-sensitive information specific to events, contests, and promotions immediately before selling to consumers.
Inline Digital Printing and New Retail

IDP was developed to help manufacturers cope with new challenges in consumer markets. These challenges are best explained by examining trends among retailers.

Distinctions between what retailers sell are disappearing. Drugstores, supermarkets, supercenters, and wholesalers stock everything to meet consumers’ daily needs. The key distinction is now whom retailers target. For example, drugstores target consumers seeking convenience; supercenters target consumers seeking value; bulk wholesalers target groups (e.g. families) seeking value.

Strategies centering on whom have fragmented packaging into a myriad of sizes. Products are now available in single-serve size, individual size, family size, restaurant size, and numerous in-between sizes.

Competition over what still exists, however—no longer at the category level (e.g. drugs vs. food) but now at the individual product level. In the new world of everything retail, retailers have developed distinctive private brands and carry increasingly specific varieties. For example, a supermarket might not only carry ranch dressing but ten sub-flavors of ranch: spicy ranch, creamy ranch, etc.

Retailers also compete in the what arena by keeping pace with consumer awareness. Retailers recognize that products packaged to address consumer concerns—such as “gluten free” or “made with real sugar”—are more desirable than identical products in uninformative packaging. Successful stores work to stock up-to-date products in order to draw health-conscious consumers.

**DRUGSTORE**
- **Primary offering:** medicines, personal care, housewares
- **More recent:** food

**SUPERMARKET**
- **Primary offering:** food, medicines
- **More recent:** personal care, housewares

**SUPERCENTER**
- **Primary offering:** housewares, personal care
- **More recent:** food, medicines

**BULK WHOLESALE**
- **Primary offering:** food
- **More recent:** personal care, housewares, medicines

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The new retail landscape shown above is challenging manufacturers in four ways:

**New Outlets**—consumer goods manufacturers have ever-growing opportunities to sell through new outlets. New opportunities come with more responsibilities: each outlet has its own specifications for labeling packaging, especially secondary cases.

**Explosion of SKUs**—flagship products, sub-varieties, seasonal products, and whitelabeled products must be labeled correctly on primary and secondary packaging. Many products are also sold in several sizes, each of which requires its own packaging SKU.

**Constant design changes**—individual ingredients such as organics, whole grains, and artificial sweeteners are increasingly driving consumer behavior. Adding or removing high-profile ingredients, as well as calling attention to what a product contains (or does not contain), are critical components of marketing strategy. Packaging is under mounting pressure to keep up with these changes.

**Track and trace requirements**—Each retailer has its own specification for track and trace—many still use the UPC standard, although Code 128 and GTIN/EAN barcodes are becoming more common. Also, in response to the rapid growth of drug retailing, the US government has mandated that all drugs carry unique identifiers—such as 2D matrix codes—in order to curtail drug counterfeiting.
Inline Digital Printing and Primary Packaging

IDP can transfer information to packaging at virtually any stage of the manufacturing process. Target packaging can be pressed flat, prepared for filling, or already full at the time of printing. This technique is known as *direct-to-shape printing*.

Direct-to-shape methods help manufacturers to respond quickly to market shifts. When ingredients change or one product fragments into multiple sub-varieties, IDP can adjust package design in software and modify the package at the end of the supply chain—for example, at the bottling manufacturer or at the filling plant. This minimizes disruption:

- …from added SKUs, since packaging for multiple varieties can be printed directly on the same shape
- …from ingredient changes, since printed information can be adjusted at the point of fill with minimal lead time

Codes, numbers, and other unique identifiers for track and trace also need to be adjusted from time to time. As with ingredients and subvarieties, IDP can adjust track and trace information without disrupting the supply chain.
Inline Digital Printing and Primary Packaging, continued

IDP can be used to minimize supply chain disruption in the following situations:

- Print labels for new product varieties on the bottle forming or filling line
- Respond quickly to consumer concerns about ingredients and processes
- Switch between multiple languages on the fly at the point of fill
- Add unique identifiers or promotional codes anywhere in the supply chain

**Nutrition Facts**

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*Los porcentajes de Valores Diarios están basados en una dieta de 2,000 calorías. Sus valores diarios pueden ser mayores o menores dependiendo de sus necesidades calóricas.
Inline Digital Printing and Secondary Packaging

IDP is designed to cope with the increased volume and variety of packaging specifications resulting from new retail. Lasers, which use no liquids, ribbon, or labels, rarely malfunction; using the IDP configuration, they can image at high-speed (up to 1m/s or 197 ft/min) on moving carton lines. Manufacturers using IDP can switch seamlessly between different customers’ label requirements and adjust quickly when those requirements change.

Inline digital printing is also central to new eCommerce marketing strategies. Online retailers can personalize each box to reflect one-off items or to market new products based on customers’ ordering patterns.

**Efficient and clean:** prints content and tracking information for any customer without inkjet ink, ribbon, or labels.

**Personalized:** customizes shipping box to match one-off products.

**Targeted:** creates unique advertisements for online customers based on previous orders or page views.
**Inline Digital Printing Factsheet**

- **Print Speed**: Up to 1 m/s (197 ft/min)
- **Print Height**: Up to 100 mm (4 in)
- **Print Resolution**: Up to 300 dpi
- **Consumables**: No consumables at the point of printing
- **Uptime**: More reliable than inkjet and thermal transfer; maximum one hour of downtime per month estimated
- **Contrast**: Minimum B-grade barcodes on white background; minimum B-C codes on nonwhite background
- **Substrates**: Polyethylene, Polypropylene, BOPP, paper, Polyolefin, foil films, corrugate, folding cartons, others

*Will not distort thin films used in labels and flexibles*
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