



4 Ways to Reduce Secondary Packaging Costs by Replacing Pre-Printed Corrugated Boxes with Direct Carton Marking

WHITE PAPER

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► Introduction

Virtually ubiquitous as the standard for secondary packaging of products around the world, boxes made of corrugated fiberboard are anything but standard when it comes to the variety of styles and sizes. Although regular slotted containers (RSCs) are the most commonly used style of box, they are offered in more than 1,300 different sizes.

That broad range of available sizes makes it possible for shippers to most closely match the internal box dimensions to the size of its contents. For financial reasons particularly with the recent movement of parcel shippers from weight-based to dimension and weight (DIM Weight) charges it makes the most sense to package items for shipment in a box sized to minimize empty space inside the carton. Otherwise, to protect the product(s) inside from shock, vibration, compression or other factors, the empty space must be filled with some type of additional packing material.

To reinforce their brand and visually identify their shipments, many companies such as e-commerce retailers and third-party logistics (3PL) service providers use corrugated shipping cartons that have been pre-printed with graphic logos, brands, fonts and/or messaging. It is not, however, feasible for secondary packagers and shippers of products to stock every possible pre-printed carton size they may need.

Instead, most shippers attempt to analyze their outbound order fulfillment data and stock keeping unit (SKU) profiles to determine the carton dimension(s) their shipments most commonly require. Depending on this information, operations may elect to maintain a pre-printed box inventory anywhere from five to 50 (or more) different carton sizes.

Offered as a more cost-effective alternative to stocking pre-printed corrugated boxes, direct carton marking employs high-resolution inkjet printers to imprint text, graphics and barcodes directly onto each box as needed. This white paper explains how direct carton marking technology works and outlines the four ways a shipper can reduce costs by replacing pre-printed boxes with direct carton marking.

► How Direct Carton Marking Works

Direct carton marking utilizes high-resolution inkjet printers to produce high quality text, graphics and barcodes on corrugated boxes, either before or after they are formed. The technology can also be used to imprint trays and other porous materials.

High-resolution inkjet print heads employ one of two technologies to propel drops of ink onto a target surface:

- + **Thermal inkjet print heads** use tiny, electrically heated resistors to vaporize the ink, causing an air bubble to form. As the bubble expands, it forces out a drop of ink.
- + **Piezoelectric inkjet print heads** use an electric charge to deform a ceramic material in the ink feed nozzle. The deformation forces out the ink.

Because they produce marks on-demand, these printers can be used not only to custom brand a box with a shipper's or 3PL customer's logo, but also for printing of variable information such as lot numbers, sell by or use by dates, and other codes.

Low Maintenance Requirements

More convenient than adhesive backed labels that must be stocked and create waste from backing that must be discarded, the print heads' inkjet output is supplied by a bottle or via a connection to a bulk reservoir of ink. Ink can be added to the system at any time, without requiring a production line stoppage. Further, some inkjet technologies automatically recirculate the ink, improving usage. Depending on the volume of direct carton marking required in a given application, ink may be refilled as infrequently as once a week. This provides long run times with minimal manual intervention to refill ink supplies.

Maintenance for direct carton marking high-resolution print heads is minimal. The print heads seldom require more than a periodic purge, which is a simple routine triggered from the printer's human machine interface (HMI) manually or via a timer. This periodic purging eliminates potential valve clogs which may occur from dust or debris accumulating in the print head nozzles. Additionally, certain print heads can reuse the purged ink from a cleaning cycle. After the ink is vacuumed back into the print head, it is filtered and recycled back into the reservoir for use, ensuring that ink is not wasted.

Thermal inkjet print heads also require minimal maintenance. Ink is typically supplied in one of two ways: either via single use cartridges or a bulk ink system that supplies a fixed cartridge. For applications that employ single-use cartridges, when the current cartridge is depleted, it is removed and a new one snaps easily into its place. Fixed cartridges are swapped out less frequently, as the bulk ink reserves are primarily refilled from pre-measured bottles.

Mark Quality

The American National Standards Institute (ANSI), working with GS1, has established universally accepted barcode quality standards. Barcode quality is assessed based on eight different characteristics utilizing quality control verifiers. The verifier assigns a grade, or rating, on either a scale of 0 to 4 or a letter (A, B, C, D or F). A "C" rating means that a barcode should be scannable on the first attempt by nearly any automatic identification data capture (AIDC) device. A better quality rating, such as "A" or "B" means the barcode can be decoded at progressively faster rates.

Because speed of decoding is important throughout a supply chain including within a warehouse, during shipment and at retail locations many retailers require C-grade (or better) quality from barcodes printed on secondary packaging. However, it can be extremely difficult to achieve the highest quality (A- and B-grade) codes on cardboard boxes pre-printed via a flexographic process. That's due to the thick, spongy nature of the corrugated material. To achieve higher grades in pre-printed boxes, a more expensive corrugated material that includes a high-quality fiber paperboard outer layer must be used.

Alternatively, high-resolution print heads can be configured in-line on an existing (or new) conveyor system to produce A- and B-grade quality barcodes. Special, integrated box guides that simultaneously reduce vibration and ensure the correct distance between the print head and the target ensure the desired code quality, eliminating rejects and scrap.

Unrestricted Imprint Size, Detail and Colors

A single high-resolution inkjet print head can produce images as small as 1/32 of an inch up to 4 inches in height. Grouping multiple print heads together can create even larger, stitched images up to 132 inches in height for special branding or marking applications. For operations that require repeatable imprinting of high-quality logos, fonts, images and graphics, some high-resolution print heads produce 768 dots to create a 4-inch-tall image, or approximately 50 lines of text. The higher a print head's resolution, the better the quality of the graphics it can produce particularly those incorporating curves, angles, shades or screens and other fine details.

Systems equipped with high-resolution inkjet print heads can produce up to four spot colors in a single imprint. That's because each print head is supplied by a different ink color (black, red, green and blue are most commonly used), while a single controller directs their combined output. This feature can support branding initiatives, as well as accommodate special markings to highlight a message. The speed of high-resolution print heads is adjustable in direct carton marking applications. When paired with an encoder that automatically adjusts to variable conveyor speeds, the print heads can be programmed to print on-demand. Depending on the required output resolution of the text or graphics, high-resolution print heads can produce images ranging from 1.6 to 6.6 feet (0.5 to 2 meters) wide at speeds up to 276 feet-per-minute (84 meters-per-minute).

Centralized Imprint Design Management

Certain direct carton marking control systems have integrated design and interface capabilities. In addition to providing centralized, universal print management, these systems offer the ability to manage not only ink jet direct carton marking printers, but also printers for primary and tertiary packaging, as well. Thus, data to be encoded on primary products plus secondary and tertiary cartons or film overwraps can be designed and maintained by an easy-to-use touchscreen controller interface, eliminating the need to learn and update multiple systems.

Further, to reduce coding errors and offer productivity assessments, the system seamlessly integrates with existing enterprise resource planning (ERP), manufacturing resource planning (MRP) and warehouse management system (WMS) software. The system incorporates integrated client and security levels to meet regulation coding and track and trace requirements.

Single, Universal Print Controller

Though multiple print-and-apply labelers may be able to receive label formatting details and data from a single PC, logistics and functionality can quickly become complicated. Most label creation and control software is PC-based and does not include functionality needed for production line triggers, such as encoders and sensors. Instead, a programmable logic controller (PLC) is required to interface with the production line.

Certain direct carton marking systems are packaged with a single, universal print controller to manage multiple print heads, including different technologies or brands. These systems incorporate built-in input ports to interface with encoders and sensors, alleviating the need for a PLC. These systems are able to manage multiple printers on one production line or on multiple production lines simultaneously. The status of each printer in the network is easily viewed via a touch screen.

Further, multiple technologies on a production line at primary, secondary and tertiary marking locations can be managed by one direct carton marking system. Connected via an Ethernet network, these fully scalable systems can be easily expanded because each print head is assigned a unique IP address when added to the line.

► 4 Ways to Save with Direct Carton Marking

Because direct carton marking is an on-demand imprinting technology that can be deployed as needed, it can reduce an operation's annual secondary packaging costs in four areas: box costs, inventory/working capital, repurposed storage space, and reduced scrap.

Box Costs

There are a variety of costs associated with the purchase of pre-printed cardboard cartons. To reduce those costs, suppliers offer price breaks by quantity. However, if an operation requires a large variety of box sizes, or a broad variety of imprints, ordering in large quantities may not be the most cost-effective option.

Instead, by switching from pre-printed cartons to blank boxes that are printed on-demand at the packing location either in-line or near the production line savings can be realized in a number of ways. Among them, improved box pricing from suppliers by ordering larger quantities without pre-printing setup costs.

For example, an operation running a single, 8-hour shift that uses 200,000 pre-printed RSCs per month (in four different types and two sizes) and stores two weeks of inventory, might save only 5% by increasing their normal order from 12,000 to 48,000 pre-printed cases a reduction in per-box-cost of \$0.0075 (from \$0.15 to \$0.1425 per pre-printed RSC). By switching to direct carton marking, the same number of cartons could be imprinted on-demand and requiring a monthly average of six 500-milliliter bottles of ink and resulting in annual savings of more than \$4,500.

Inventory/Working Capital Costs

Operations using pre-printed cartons must tie up working capital by maintaining a safety stock of inventory depending on how quickly they use up their secondary packaging reserves typically measured in weeks. Alternatively, by converting to direct carton marking on an as-needed basis, corrugated box inventory can be reduced in both the types and styles needed, and the quantities.

For example, the same operation discussed above might maintain a week's worth of pre-printed RSC inventory, as well as an additional week of safety stock per case size and type, meaning nearly 770,000 boxes must be stored. By switching to blank RSCs that are direct carton marked on-demand, the operation would only have to stock 192,000 cases, resulting in a simultaneous reduction in inventory and freed up working capital of more than \$85,000 per year.

Storage Area Costs

Maintaining an inventory of pre-printed boxes required a dedicated storage space (or spaces) to hold not only a certain amount of inventory for a production run, but also a

certain amount of safety stock to ensure adequate supplies. Switching to direct carton marking not only ensures that boxes will be available for a full run, but also frees up space for additional production or other value added activities. This increases an operation's flexibility by allowing packaging activities to be performed based on product availability, not packaging availability.

For example, by converting to on-demand direct carton marking of blank RSCs, the same operation described above could reduce its required storage area for inventory and safety stock of 768,000 pre-printed cartons in 3,072 square feet by more than 2,300 square feet. That's because the 192,000 blank cases only require 768 square feet of storage. At a rate of \$10.40 per square foot of facility space, that represents an annual savings of nearly \$24,000.

Scrap Costs

One of the drawbacks of buying pre-printed cartons in higher quantities to achieve supplier price breaks is the risk that a certain amount of those cartons will become obsolete before they are used. This could be due to a potential change in product, branding, production or other standard. Further, the more pre-printed boxes stored in inventory, the more likely the chance of damage due to environmental or accidental causes.

By converting to on-demand direct carton marking technology, live data changes can be instituted at the universal print controller level prior to imprinting eliminating obsolescence. This technology also allows specials or promotions to be printed on-demand instead of pre-ordered for on-the-fly marketing initiatives. Finally, a smaller total inventory of blank boxes must be stored, lowering the chance of damage that results in scrap.

Again using the aforementioned example, a conversion to on-demand direct carton marking eliminates scrap. For an operation that scraps 2% of its annually-purchased 2,400,000 pre-printed cartons, preventing scrap results in more than \$7,100 in savings annually.

Reviewing the Savings

Upon review of the potential savings that can be gained from replacing pre-printed corrugated boxes with direct carton marking of blank RSCs, on demand, via high-resolution inkjet printers, the financial benefits are clear. Direct carton marking offers a multitude of savings by reducing stocking requirements, inventory/working capital, square footage and obsolete scrap.

► Conclusion

Now available: High-resolution direct carton marking delivered by the MPERIA® platform. The complete package from Matthews Marking Systems includes the VIAjet™ T-Series and L-Series high-resolution print heads, controlled by the MPERIA® universal print platform. Matthews's Custom Solutions team can ensure a seamless integration with your existing production line. Using MPERIA™ platform will simplify printing and coding, while providing the cost savings outlined above.

The **VIAjet™ T-Series** high-resolution print head prints directly onto porous paper surfaces and includes two models: the T100 for side, vertical printing and the T100S for down, right angle printing. T-Series print heads produce high-resolution certification marks, barcodes, text, logos and other graphics at image heights up to 4 inches per head. Multiple heads can be grouped together to produce stitched images at unlimited sizes. To make accessing space-restricted production areas easier, and to extend the accessible print area, the print heads can be equipped with a 27.5-inch flexible umbilical ink feed tube that connects the print head to the ink tank. It utilizes specially formulated, highly pigmented inks that dry on contact to produce bold, crisp images with minimum bleed ideal for precise barcodes and graphics.

The **VIAjet™ L-Series** high-resolution thermal inkjet print head prints 600 x 600 dots-per-inch (dpi) at rates up to 200 feet-per-minute (60 meters-per-minute) twice as fast as other thermal inkjet printers. Each print head can create image heights ranging from 0.5 to 2 inches. Mountable in either horizontal or down orientations, the print heads can be supplied by either single-use ink cartridges or bulk ink. To reduce ink consumption and improve uptime, the print heads feature an advanced nozzle design. The L-Series can be used with a variety of inks for both porous corrugated direct carton marking, as well as printing on coated or non-porous materials.

The **VIAjet™ V-Series** large character DOD print head features reliable valve technology to mark on porous and non-porous substrates, including paper, coated and uncoated corrugated fiberboard, and corrugated plastic. Its large character print output ranges from 3 to 127 millimeters (0.125 to 5 inches), and can be expanded by grouping multiple print heads to produce stitched images at unlimited sizes. Ideal for variable data marking coding of products for traceability purposes, the unit uses specially formulated pigmented inks that dry on contact.

MPERIA® allows users to control multiple production lines, integrate order processing, populate production data from order processing files, and interface with new or existing databases all from a single, centralized controller. It integrates easily with enterprise resource planning (ERP), manufacturing resource planning (MRP) and warehouse management system (WMS) databases to reduce coding errors and efficiently manage and coordinate multiple printers simultaneously. This universal print system features an intuitive, touch screen controller interface with built-in image editor to make message creation and selection simple.

Visit www.gsinks.com to learn more about this unique system and to schedule your in-facility demonstration today.