



Replacing Secondary Packaging Labels With Direct Carton Marking: 10 Benefits

WHITE PAPER

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► Introduction

Adhesive-backed labels of all shapes and sizes are applied to secondary packaging of manufactured and distributed products in virtually every industry. Companies that package products in a corrugated shipping carton or shrink-wrapped corrugated tray likely uses labels. Label content typically includes static or variable text and barcodes for identification as:

- + License plate numbers (LPNs) for internal tracking
- + Carrier and recipient information for shipments
- + Lot, batch or unit information for traceability
- + Product name information related to the items in the carton
- + Special handling instructions
- + Logos, branding and/or messaging to support marketing initiatives
- + GTIN distribution barcodes

Most operations use label printer applicators to imprint and affix labels to cartons or overwrap. These automated print-and-apply machines employ either direct thermal or thermal transfer technology to print on the face of the label substrate. Direct thermal burns an image onto specially formulated, and more expensive, label stock. Thermal transfer utilizes a ribbon coated with wax, resin or a mix of both, applies heat to the ribbon and melts the coating onto a standard paper-based label.

Once printed, the machine applies the printed label to the carton. It may use either a pneumatic or electric cylinder that actuates a pad that, in turn, presses the label onto the carton. Alternately, machines with an air-blow application system release a burst of air that propels the label onto the carton. Throughout the print-and-apply process, an

integrated media handling mechanism controls the rate at which the roll of label stock is fed into the machine. It also separates the label from its paper backing, and rewinds the empty backing for later removal.

Automated print-and-apply of adhesive-backed labels has its drawbacks, however.

Among them:

- + Capital equipment cost of the machinery
- + High cost-per-print due to associated consumables (labels, ribbons, print heads)
- + Storage and management of associated consumables (labels, ribbons and waste rolls)
- + Downtime required for multiple label roll changeovers per shift and to correct jams
- + Maintenance and repair of mechanical components
- + Restriction of message size and detail to the limits of each label's dimensions
- + Production of multiple label sizes requires multiple machines
- + Production speed limitations
- + No centralized label design management system
- + Multiple print controllers required to manage machinery and imprint contents

Offered as an alternative printing methodology, direct carton marking employs high-resolution inkjet printers to imprint text, graphics and barcodes directly onto a corrugated carton or tray. This white paper outlines the 10 benefits an operation can gain from replacing secondary packaging labels with direct carton marking.

▶ 10 Benefits of Replacing Labels with Direct Carton Marking in Secondary Packaging Applications

Direct carton marking with high-resolution inkjet printers in secondary packaging applications produces high quality text, graphics and barcodes on corrugated cartons, trays and other porous materials. Because they produce marks on-demand, they provide tremendous convenience in printing variable information, such as batch information, date codes or custom branding.

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.

Switching from print-and-apply adhesive labels to direct carton marking with high-resolution inkjet printers yields the following 10 benefits:

Benefit #1: Lower Overall Capital Equipment Cost

Because most print-and-apply labeling occurs on more than one side of a carton (opposite or adjacent panels and the top are the most common label placement locations), as many as two or three separate label print-and-apply machines may be required.

Because each applies a different label size and information—including LPNs for internal tracking, carrier and recipient information for shipments, and lot, batch or unit information for traceability—traditional print-and-apply machines must be programmed and controlled independently. (If a single machine is used to apply labels to adjacent sides of a box, an automated device may be incorporated into the conveyor system to rotate the carton.) Further, where the print-and-apply labelers are physically located on a production line may be limited to the areas that are most accessible for label changeovers, jam clearing or routine maintenance activities.

Alternately, direct carton marking utilizing high-resolution inkjet print heads with a single controller directing the output of each print head is a far more cost effective alternative. Print heads may be installed in two orientations—side or down printing orientations. They can also be installed directly on conveyors, cartooning equipment, floor-mount stands, or onto vertical knockdown case feeding equipment. This versatility yields a lower overall capital equipment investment.

Benefit #2: Reduced Cost-per-Print by Eliminating Associated Consumables

When comparing the cost-per-print of direct carton marking against that of thermal transfer and direct thermal label printing, direct carton marking saves money. That's because direct carton marking doesn't require labels or ribbons to create text, images or barcodes—just ink.

Print-and-apply adhesive label stock comes in a variety of standard and custom sizes, with the most common label measurements ranging from 1.5 x 1 inches to 4 x 6 inches. Costs for blank stock varies based on the required size and quantity of the labels, with pre-printed label stock costing up to twice as much (or more). For applications that require labels to be affixed to multiple sides (opposite or adjacent panels, for example) label printing costs increase accordingly, even with bulk quantity discounts.

In contrast, in direct carton marking with high-resolution inkjet print heads, ink is the only consumable. Because the ink can be supplied in bulk and has a shelf life of 12 months, it costs just a fraction of a percent of the cost of printing and applying adhesive-backed labels. The cost for direct carton marking of 1,000 cases on two sides with typical branding, barcode and lot numbers? As low as \$3.00 per 1,000, and up to 25 times lower in cost than adhesive labels, as shown in the two tables on the following page.

**DIRECT CARTON
MARKING vs
THERMAL TRANSFER
LABEL PRINTING**
\$ PER LABEL

	1.5" x 1"	Thermal Transfer	Ribbon	Total	Direct Carton Marking	Savings
1.5" x 1"						
Small Quantity		.90	.30	1.20	.10	1.10
Large Quantity		.80	.30	1.10	.10	1.00
2" x 4"						
Small Quantity		3.50	.40	3.90	2.00	1.90
Large Quantity		3.00	.40	3.40	1.30	2.10
4" x 6"						
Small Quantity		8.40	3.00	11.40	4.50	6.90
Large Quantity		7.70	2.90	10.60	2.60	8.00

**DIRECT CARTON
MARKING vs
DIRECT THERMAL
LABEL PRINTING**
\$ PER LABEL

	1.5" x 1"	Direct Thermal	Direct Carton Marking	Savings
1.5" x 1"				
Small Quantity		2.20	0.01	2.19
Large Quantity		.190	0.1	1.80
2" x 4"				
Small Quantity		5.50	2.00	3.50
Large Quantity		4.70	1.30	3.40
4" x 6"				
Small Quantity		12.60	4.50	8.10
Large Quantity		10.80	2.60	8.20

Benefit #3: Minimal Storage and Management of Consumables

Operations using print-and-apply labelers must store and manage the consumables—labels, ribbons and waste rolls—associated with their operation. A dedicated space, preferably near the machine for operator convenience, is required to house these items. To avoid running out of labels, many companies carry a safety stock, meaning they order more labels than they are likely to use. A certain amount of waste can be expected from bulk-purchased labels that become obsolete before being used due to a change in either equipment or production standards. Further, it's rare that a production run deplete a complete roll of labels. Yet most facilities inventory their labels by the roll, not by the number of labels remaining on the roll.

Partial rolls, therefore, often go to waste, as operators avoid using them—either because a partial roll's performance is different from that of a full roll, or because they aren't sure how many labels remain and don't want to short a production run. Partials are often discarded, resulting in wasted money.

In addition to requiring dedicated space, if labels aren't stored in an environment with properly controlled temperature and humidity, they may develop a curl that corresponds to the curve of their storage roll. Curled labels resist full pick-up by tamp pads or air-blow applicators, a common cause of jams. Along with empty rolls of waste backing, wasted labels from jammed machines are discarded, at a cost.

Alternately, direct carton marking print heads produce no label or backing waste. Their inkjet output is supplied by a bottle or connection to a tank of ink. This provides longer run times and reduces the frequency of manual intervention required to refill ink supplies. Because only one type of ink is used to mark porous corrugated cartons and trays, the space previously dedicated to storage of multiple sizes of label stock can be tremendously reduced.

Additionally, ink is less susceptible to varying temperatures, allowing it to be stored and used in environments ranging from 50° to 104° Fahrenheit (10° to 40° Celsius). Ink is unaffected by relative humidity levels ranging from 10 to 90 percent, eliminating the need for the controlled storage environment required for labels.

Benefit #4: No Downtime Required for Label Changeovers or Jam Correction

Most label rolls are supplied in lengths from 1,200 to 1,500 feet (365 to 455 meters), containing 3,000 to 6,000 labels per roll (depending on label dimensions). Every time a roll of labels runs out, or a production run requiring different pre-printed labels starts up, the roll must be changed.

The majority of print-and-apply labelers require an operator to manually swap out the roll, which can take anywhere from 30 seconds to 5 minutes per machine. And, depending on the speed of production, multiple roll changes may be required per shift. Likewise, if a roll of labels becomes jammed in the machine, the time required to clear the obstruction and reprint the wasted labels can negatively impact productivity. Further, label changeovers and jam corrections may require a full stop of the production line (companies experiencing frequent jams may attempt to prevent such issues by installing a redundant machine).

Alternatively, direct carton marking with high-resolution inkjet print heads eliminates the need for rolls of labels—and their changeovers—completely. Because the printers imprint directly onto the carton or tray, there's no label stock involved to cause jams. The print heads are supplied with ink from a reservoir filled by either a bottle or supplied by a tank. Ink can be added to the system at any time, without requiring a production line stoppage; low levels of ink can also be signaled via an audible or visual warning at a trigger point to alert operators of the need for a refill before production is halted. Depending on the volume of direct carton marking required in a given application, ink may be refilled as infrequently as once a week.

Benefit #5: Minimal Maintenance

Because of the multiple mechanical components employed in print-and-apply labelers, they require routine maintenance to keep them in proper working order. Tasks run the gamut from simple cleanings to replacement of worn or faulty parts.

On the other hand, 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 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.

Benefit #6: Unrestricted Imprint Size, Detail and Colors

Print-and-apply labelers are restricted to print output sizes that fit a label's dimensions. Modifications to a label's design must accommodate the limitations of each label's size. Alternately, a single high-resolution inkjet print head can produce images as small as 0.5 inches 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.

Additionally, whereas traditional print-and-apply labelers are limited to a single color per label, 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.

Benefit #7: Inkjet Printers Eliminate Multiple Print-and-Apply Machines

Every label size printed and applied to a carton requires a specific, accordingly sized print-and-apply labeler to handle it. The production of multiple label sizes therefore requires multiple machines. As mentioned previously, because most cartons are marked on more than one face (opposite or adjacent sides and top), as many as three different labelers might be needed.

Instead, utilizing three (or more) high-resolution inkjet print heads with a single controller directing their operation for direct marking of each carton face is a far more cost effective alternative to multi-side labeling. Because print heads may be installed in two orientations—side/vertical or down/right-angle—they accommodate both vertical and horizontal printing. And, because they are all capable of producing a variety of image heights, there's no longer a need to maintain different print-and-apply labeler equipment, or stock different label sizes.

Benefit #8: Production Speed Agnostic

As noted by the Packaging World magazine's "Labeling Playbook," print-and-apply labelers are extremely sensitive to production speed. Many facilities either underestimate the speed at which their production line will run, and wind up with a bottleneck at the label print-and-apply machine; or, attempt to compensate for variable production runs by over-specifying a machine that is too fast for actual production, causing jams.

Per the "Labeling Playbook":

Requesting a labeler to be designed for 300 per minute for a line that ends up running at 70 per minute will likely cause problems. Avoid over-specifying your speed requirements to the labeling equipment manufacturer. This can also happen if you assume each machine in the line should run 15% faster than the next slower machine to the critical machine on the line, a common rule of thumb. If your labeler is the fifth machine down from the filler, using this logic will require it to run 2-times faster than the filler, which may not be close to reality.

On the other hand, the speed of high-resolution print heads is adjustable in direct carton marking applications. When paired with sensors or photo cell-based detection systems to perceive the presence of a box or tray, the print heads can be programmed to print on-demand or automatically adjusted for various conveyor speeds. Depending on the required output resolution of the text or graphics, high-resolution print heads producing image sizes from 0.5 to 2 inches in height can run at speeds up to 1,600 feet-per-minute (488 meters-per-minute), while print heads

that produce image sizes up to 4 inches in height can reach speeds from 200 to 600 feet-per-minute (61 to 183 meters-per-minute).

Benefit #9: Centralized Imprint Design Management

There is commercial software available for label creation that can be used with a variety of print-and-apply labelers (some label creation software even has the ability to create formats for inkjet printers). The software enables easy design of labels, with features including pre-formatted and configurable counters, batch controls, user-friendly text fields and barcode symbologies to accommodate unique, on-demand message creation. These systems are usually PC based, providing simple, configurable message management and display. Labels are easily designed and can be downloaded to multiple labelers in a plant. Data can be manually entered or pulled from data bases, reducing input errors.

Certain direct carton marking control systems also have design and interface capabilities. In addition to providing centralized, universal print management, certain direct carton marking control systems also 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.

Benefit #10: 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.

► Conclusion

Now available: High-resolution direct carton marking delivered by the MPERIA®. 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' Custom Solutions team can ensure a seamless integration with your existing production line.

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 and pulp, wood, plastic, concrete and metal. 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.matthewsmarking.com/MPERIA to learn more about this unique system and to schedule your in-facility demonstration today.

ABOUT MATTHEWS MARKING SYSTEMS

Matthews Marking Systems, a member of Matthews International Corporation, provides product identification, branding and traceability solutions. With more than 160 years of experience, Matthew offers a full line of quality, high-resolution, laser, drop-on-demand valve ink jet.

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