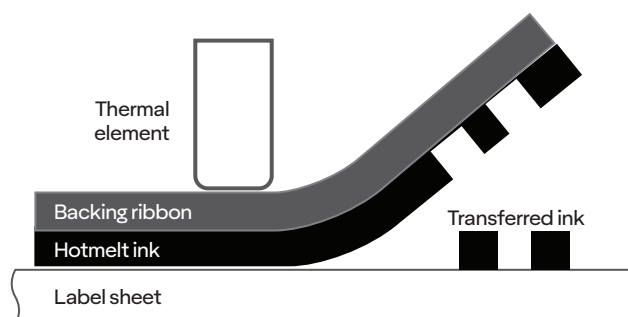# TT Printing
Basics & Best Practices

Variable Information Printing (VIP), is a printing process which allows the printed content to change in every impression. An electronic database is created which contains the variable data used to alter certain elements of each impression. Then, a special software extracts this variable data from the printhead and from there the information is transferred on substrate.

Background

Thermal transfer (TT) technology uses a heat-sensitive ribbon, which gets melted on the top surface of the label when it comes into contact with a thermal printhead and it transfers ink onto the label. The purpose of this bulletin is to know the basics of TT printing & ribbons that may be seen on applicators in the market.

Thermal element

Backing ribbon

Hotmelt ink

Transferred ink

Label sheet

I. TT Printing Substrates & Printers

When it comes to substrates for TT printing, many different materials can be used. Typically, for the purpose of self adhesive labelling, it can be papers (coated and uncoated), synthetic papers, polypropylene or a range of polyester films. Avery Dennison's team of technical experts can assist in choosing and recommending the substrate properties for specific applications.

Equally important is the printer used, because it influences the quality of the final output. Thermal transfer printers use a printhead made up of individual dots that heats up the melt ribbon onto a label. Mention below are the printhead resolutions specified in dots per inch, (dpi).

Printer resolution, dpi	Individual dot size
200 dpi	5 mil
300 dpi	3.3 mil
400 dpi	2.5 mil
600 dpi	1.6 mil

I.a Printer Types

There are two main printer types.

a. Flat print head

b. Near/ Corner Edge Printers

A standard speed, thermal transfer printer gives a resolution of 200-300dpi, at processing speeds below 8 in/s. Such printers use flat print heads and operate at lower printing speeds. High speed printers use near-edge/corner-edge print heads, which allow higher processing rates above 10 in/s. They usually operate at the resolution of 300-600dpi. With this printer type, a special ribbon and a coated substrate are needed.

I.b Printer Resolution

The effect of resolution is a lot more apparent when printing small images and text. When using low resolution, printers suffer from jagged edges when printing curves or angled lines.

I.c Other Factors to be considered

The ribbon should be wider than the label with paper and is abrasive and if the label is not covered by the ribbon, it can damage the head where the paper touches the head. The ribbon is too thin to stop the paper abrading the head unless it covers the label completely.

Avoid storing thermal transfer ribbons in direct sunlight, near open windows, near heat or conditions of dampness, in a dust environment.

## II. Construction of Thermal Transfer Ribbon

There are four layers in a thermal transfer ribbon, each layer has their own individual properties that serve a unique purpose in transfer of image to labels.

Ink Layer – It is made up of either wax/resin or resin and is transferred to the label during TT printing. This layer's composition determines heat, abrasion and resistance properties of the ribbon.

Release Layer – This layer offers the feature of enabling good ink release from PET based film.

PET Based Film – PET film is used for ink and back layer coating. This layer allows heat transfer from thermal print head to the ink.

Back Protection – This layer protects the PET based film and thermal print head, thereby reducing static electricity issues and improves ribbon movement during printing.
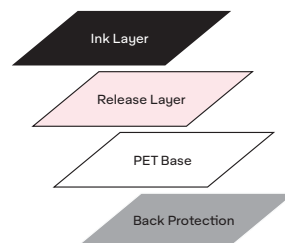
III. CSO & CSI

Thermal ribbon rolls are available with a carbon side facing in or facing out. This terminology refers to the side of the ribbon that the ink sits on. This is because different types/ models of printers have different winding paths from the core of the ribbon to the print head.

III.A) Coated Side Out (CSO) Ribbons : CSO ribbons are ink coated facing out , as ink is on the outside of the ribbon roll and it unrolls from the bottom before making contact with the printhead and label.

III.B) Coated Side In (CSI) Ribbons : CSI ribbons are ink coated facing in, as ink is inside a ribbon roll and it unrolls from the top before making contact with the print-head and label.

We can determine ribbon winding direction by using a tape test. Stick a piece of tape to the outside of the ribbon roll. After a few seconds, peel the tape off. If ink sticks to tape, then it is CSO ribbon. If ink does not stick to tape, then it is CSI ribbon. We can also identify between these two by gloss difference as well, the matt side is where the ink sits on.

IV. Types of Ribbons

There are basically three types of ribbons. Finding the right type of ribbon can be an important step in ensuring labels are scannable, readable and durable.

Parameters	Wax Ribbon	Wax Resin Ribbon	Resin Ribbon
Usage	Economical & low abrasion, made for short term use	Frequent handling – medium & made for standard use	Expensive & highly durable; made for long term use
Type	Colorant - Wax substance	Wax + Resin based colorant	Colorant – Resin substance
Image Transfer	Low melting point	Moderate melting point	High melting point
Material recommended	Coated & uncoated paper stock, TT paper	Gloss paper stock, TT paper + some synthetic stock	Synthetic material
Resistance	Moderate scratch/ smudge & chemical resistance	Good abrasion, chemical & environment protection	Excellent resistant to abrasion, smudge, chemical & environmental resistance
Application	General purpose labelling, Shipping labels, Garment/ retail tags, Price tickets, Warehouse application	Indoor use, Moisture handling, Abrasion, Outdoor application with moderate temperature changes	Apparel labels (taffeta/ satin), Synthetic material like polyolefins, PET, Destructible vinyl, Warranty void TE labels, Chemical drum labels, Pharma labels, Durable – Electric, Industrial,Automotive labels

V.a Advantages:

- Thermal transfer delivers crisp, high-definition text, graphic and barcode print quality for maximum readability and scannability.

- Thermal transfer printing produces long-life image stability.

- Thermal transfer enables batch or single label printing with virtually less wastage.

- Low maintenance cost compared to inkjet and laser printing.

- Thermal transfer technology can print on a larger variety of media stock.

V.b TT Printing: Right Selection

Material Type	Ribbon type	Darkness	Speed, "/s
TT face	Wax & Wax Resin	10 to 25	2 to 8
Semi Gloss/ High Gloss	Wax & Wax Resin	10 to 25	2 to 8
Synthetic paper	Wax Resin & Resin	10 to 25	2 to 8
PP	Wax Resin & Resin	10 to 25	2 to 8
PET	Wax Resin & Resin	10 to 25	2 to 8

- TT printing parameters should be finalized based on different printer darkness and speed settings.

- Printer and ribbon will have unique printhead specification & ribbon printing properties, to ensure good TT printing results.

- Compatibility test is recommended for right selection of PS material, ribbon and printer settings.

VI. FAQ's

How often should I clean my printhead & What is the safest way to clean it ?

It is recommended to have periodical cleaning of the print head, preferably daily before starting printing.

Using soft lint free fabric for cleaning is suggested, by dipping fabric with diluted IPA and cleaning printhead delicately in one-direction.

What is the difference/ advantages in ultra/ super wax compared to regular ribbon ?

There are standard and premium ribbon variants available in the market.

Wax & resin % ratio will vary in this ribbon. Higher resin % delivers more abrasion resistance, higher energy is required for melting.

What resolution printer is used for resin ribbon ?

Starting resolution starts with 200 dpi, range varies from 200 to 600 dpi

(For small font size, higher resolution is recommended)

No criteria is suggested in selecting printer resolution for different types of ribbons.

How to select the right ribbon for TT printing?

Ribbon should be selected on the basis of application, chemical resistance, abrasion resistance and label substrate compatibility.

Is it possible to use leftover ribbon ?

In some printers ribbon saver options are available, where labels will move to & fro like intermittent press to use ribbon efficiently.

VI. Troubleshooting

Printing Defects	Possible Cause	Solutions (Recommended)
Poor Edge Definition (bar codes /alphanumerics)	• Print speed is too high	• Reduce print speed
	• Ribbon and media are incompatible	• Test compatibility of ribbon and label
Bar Codes Smearing (barcode edges "bleeding" or "feathering")	• Printhead darkness is too high	• Reduce darkness until bar edges are clean
	• Print speed is too high	• Reduce print speed
	• 90° Barcode (Ladder type) is being used	• If possible, change label design to normal (fence type) bar codes/ use high-end ribbon
Bars in Bar Codes Are Too Wide or Too Narrow Resulting in a Poor Scan Grade	• Print speed is too high	• Reduce print speed
	• Underburn (not enough ribbon transfer)	• Increase printhead darkness or use a ribbon with higher sensitivity (refers to ribbons requiring less energy)
	• Overburn (too much ribbon transfer)	• Reduce printhead darkness or use a ribbon with lower sensitivity (refers to ribbons requiring more energy)
	• Bars too thick	• Reduce printhead darkness
Insufficient Print Contrast	• Label surface is too dark to provide proper contrast between bars and background	• Choose label with lighter surface colour
	• Printhead darkness is too low	• Increase printhead darkness
Printed Image is Full, But Greyish or "Translucent"	• Printhead darkness is too high	• Reduce darkness
	• Printhead pressure is too high	• Reduce printhead pressure
	• Ribbon and media are incompatible	• Test compatibility of ribbon and label
Voids in Printed Image: Areas Where There Is No Print	• Dust on label	• Remove dust with compressed air. Place static tinsel across label unwind
	• Tag or label surface is inconsistent (including colour flood coating)	• Choose face sheet or flood coating inks specifically designed for thermal transfer
	• Ribbon and media are incompatible	• Test compatibility of ribbon & label
	• Printhead elements or "dots" are dirty or obstructed	• Clean printhead with isopropyl alcohol
	• Printhead elements or "dots" are burned out	• Replace printhead
	• Printhead misalignment	• Check for alignment-related defects with a known well-performing ribbon/media combination; realign if necessary

Printing Defects	Possible Cause	Solutions (Recommended)
Streaks or "Dead Spots" in Printed Image	• Ribbon is wrinkled • Poor coating quality on label surface • Printhead elements or "dots" are dirty	• See Ribbon Wrinkling • Check with label supplier • Clean printhead with isopropyl alcohol
Not Printing Any Image (or barely any image)	• Ribbon is loaded backwards • Ribbon and media are incompatible	• Use tape to determine ribbon is coated inside/ outside • Test compatibility of ribbon and label
Ribbon Wrinkling	• Printhead darkness is too high • Rewind tension is greater than unwind tension • Label liner is migrating out of feed path • Ribbon is too narrow or wide for media	• Reduce printhead darkness • Adjust tension (unwind should be greater than rewind) • Make sure label roll is flush against printer on label roll bar and label guide bar is up and just beyond outside edge of label liner • Make sure ribbon width is equal to, or slightly greater than, media width
Excessive Sticking Between Ribbon and Label	• Printhead darkness is too high • Printhead pressure is too high • Angle at which label is exiting the printer is too steep • Adhesive bleed from die cut area is sticking to ribbon	• Set energy setting as low as possible while still achieving acceptable print quality • Reduce printhead pressure • Reduce printhead energy setting • Replace die-cut label with no adhesive bleed rolls
Die-Cut Labels Continue to Feed Without "Calibrating"	• Label sensor is dirty or obstructed • Printer is set in "continuous" mode • Die-cut label length is less than minimum length for specific printer model • Label sensor may not be aligned properly with gap between die cut labels	• Clean sensor with isopropyl alcohol or compressed air • Change setting to "label" mode in label software • Check with printer • Realign label sensor

Industry references:

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