

ITW Thermal Films
TTR – 101

December, 2005

Barcode Thermal Transfer Printing Overview

What is a Thermal Transfer Ribbon?

Thermal Transfer Ribbons are comprised of a polyester film – "the support medium," which is coated with a wax-base ink, resin-base ink or a combination of wax and resin. The application, substrate, and environmental conditions will ultimately determine what type of thermal transfer ribbon is required. The non-ink side of the ribbon, called the back coating, is generally made of a silicone-base compound that serves as a lubricating agent. The back coating comes in direct contact with the printhead and enhances the thermal transfer printing process by preventing wear or damage to the printer's printhead. A leader tape precedes the imaging components, while a trailer tape may or may not appear at the end of the roll.

Explain the Process of Thermal Transfer Printing.

Thermal transfer printing is a process that requires a thermal transfer printer, thermal transfer ribbons, software and a substrate (i.e., label or tag stock). Each printer uses a self-contained print head. A printhead consists of up to 600 micro hot spots per inch. The hot spots are actually energized matrix print head wires. As the ribbon passes between the printhead and the substrate, the wires are turned on and off to melt the wax, midrange, or resin based ink off of the polyester coating to transfer the image onto the substrate.

What are the Market Trends for Thermal Transfer Ribbons?

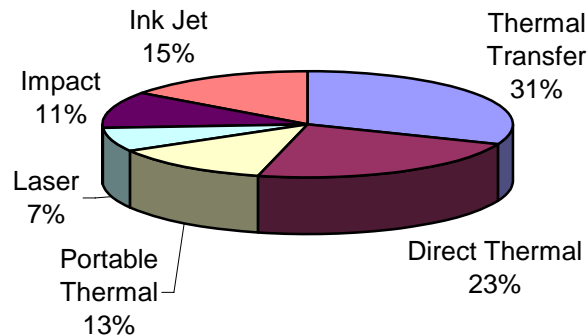
- Annual market growth is 2-5% per year
- Faster printer speeds (up to 12 inches per second)
- Increased use of film media for harsh environments
- Lower cost ribbons and commodity papers
- More specialty applications

Barcode Printing and its role in Automatic Identification Technologies - “Auto-ID”

The evolution of the bar code as the predominant source for identification of product, inventory, people, and numerous other assets drives our industry and is the life source for our place in the labeling markets. The use of bar codes dominates auto-id technologies, accounting for approximately 75% of applications requiring immediate “asset” identification.

Competing/complementing technologies include: Radio Frequency Identification (RFID), Magnetic Stripe, “Smart Card” ID and Biometric Identification. More importantly however, is gaining an understanding of the competing processes & technologies for applying bar codes to both pressure sensitive labels and non-pressure sensitive films and media.

North American Shipments of Barcode Printers (% of dollars) – 1999 total \$951.2 Million



Source: VDC Barcode Market Overview 2000

Impact Printing

Advantages	Disadvantages
<ul style="list-style-type: none"> • Oldest Technology • Extremely user friendly • Reliability • Inexpensive • Minimal software requirements 	<ul style="list-style-type: none"> • Maximum resolution 360-400 dpi (Most are under 200 dpi) • Monochrome only • Not "variable friendly", batch oriented • Limited resolution does not allow for newer bar code schemes • Declining number of installations

Laser

Advantages	Disadvantages
<ul style="list-style-type: none"> • Best for "batch oriented" applications; Prints full page at a time, standard width is 8.5" • High resolution • Low operating costs • Continuing hardware cost decline will spur growth 	<ul style="list-style-type: none"> • Slow • Limited durability • "Hot Fusing" technology limits range of media • High cost of entry • High maintenance costs

Ink Jet

Advantages	Disadvantages
<ul style="list-style-type: none"> • High integrity bar codes • Easy loading of consumables • Color capability/flexibility • High print speeds - Large Character 250-400'/min, Small Character 600-1200'/min 	<ul style="list-style-type: none"> • Durability questionable • Limited media compatibility • Quality decreases over long runs • High cost of entry

Direct Thermal

Advantages	Disadvantages
<ul style="list-style-type: none"> • Single consumable requirement • High speed capability • Extremely portable • Improving image durability and stability 	<ul style="list-style-type: none"> • Media tends to discolor • Poor durability • Poor UV stability over long term

Thermal Transfer

Advantages	Disadvantages
<ul style="list-style-type: none"> • Exclusive to bar code labeling markets • Excellent durability • High bar code integrity/quality-achieves highest scan rates • Capable of printing extremely small images/bar codes • High print resolutions • Portability • Up to 12 ips print speed • Longer printhead life due to ribbon back coating process (over dt) • Pricing has matured and is near cost of direct thermal on a per unit basis • Low cost of entry 	<ul style="list-style-type: none"> • Cost of consumables (media & ribbons) is high relative to ink jet & direct thermal • Media/Ribbon loading process is not always "user friendly"

Thermal Transfer Vs. Direct Thermal

Thermal Transfer

- Uses a ribbon to create the image
- Ribbon and label move together through the printer and the used ribbon is wound on a take up spindle or core
- Ribbon that is coated with a wax or resin based ink advances between the printhead and the substrate, transferring the image from the ribbon to the substrate.
- Various ribbon grades provide a solution for diverse print applications
- Thermal transfer label materials are less expensive than direct thermal materials
- Thermal transfer label materials are more sensitive than direct thermal
- Thermal transfer label materials have a longer shelf life and are more durable than direct thermal materials, especially when exposed to heat and solvents
- Thermal transfer process enables the user to get more life out of the printhead than the direct thermal process
- Thermal transfer enables customer to use a variety of scanners unlike direct thermal

Direct Thermal

- Heating elements in the printhead are selectively heated to create an image when they fire against the label material and activate a chemically coated dye within the substrate itself to form an image
- Single consumable requirement
- Poor durability
- Media tends to discolor
- Material must be matched to the printhead of the printer
- Reduced variety of scanner options when compared to thermal transfer
- Printhead life is reduced and user spends more money on printheads because:
 1. Printers must run at a higher temperature because the materials are often less sensitive than thermal transfer
 2. Higher degree of friction is created by label running against the printhead

Why Thermal Transfer Printing?

High Volume Printing Requirements. Thermal transfer printers are designed to complete a full label-printing job in one run. They can print up to 60 linear feet of labels per minute. This assists with long run labeling assignments.

Reliability. Thermal transfer printers have one moving part – the paper feed roller. Printers are very reliable and are designed to operate in harsh conditions, including both warehousing and manufacturing environments.

Bar Code Legibility. Thermal transfer printers create bar codes with good scan quality. Read rates (98%-100%) are far better than those produced on a dot matrix printer.

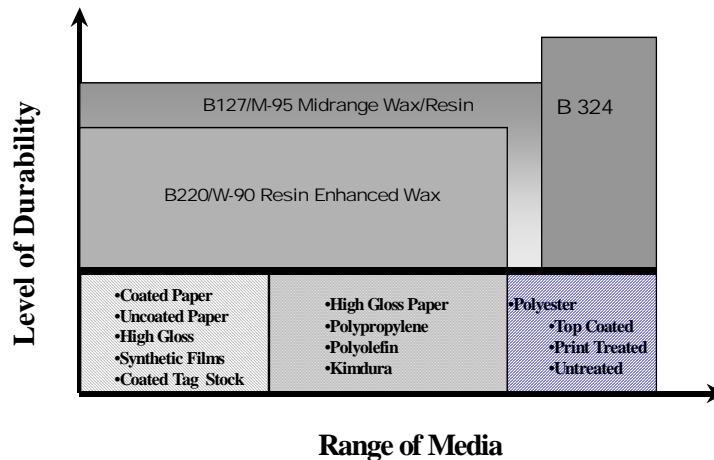
Durable Print Images. Thermal transfer ribbons have the capability of printing images that can resist extreme temperatures. In addition, thermal transfer ribbons allow for varying degrees of smear, scratch and solvent resistance.

On-demand Printing Capability. Thermal transfer printing gives the user printing flexibility. Users can print on demand and don't have to pay the extra costs associated with working with an outside supplier to create pre-printed labels.

Are There Different Types of Thermal Transfer Ribbons Available?

There are three basic categories of thermal transfer ribbons. They include wax, midrange and full resin formulations. Below are examples of the characteristics of each ribbon and possible applications for each.

Formulation	Qualities	Applications
WAX	<ul style="list-style-type: none"> ➤ Low Cost Solution ➤ Excellent Barcode Integrity ➤ Primarily for Paper Labels – ➤ Some Synthetic Films 	<ul style="list-style-type: none"> ➤ Compliance ➤ Inventory Control ➤ Product Identification (PIL) ➤ Document Tracking ➤ In Line Printing ➤ Apparel Tags & Labels
WAX/RESIN	<ul style="list-style-type: none"> ➤ Increased Scratch/Abrasion Resistance ➤ Solid Cost/Value ➤ Increased Heat Resistance ➤ Some Chemical Resistance 	<ul style="list-style-type: none"> ➤ Shelf/Bin Labeling for Longer Label Life Requirements ➤ Apparel Tags & Labels ➤ Nursery Tags ➤ Beef/Poultry Processing
FULL RESIN	<ul style="list-style-type: none"> ➤ Excellent Heat Resistance ➤ Excellent Chemical Resistance ➤ Scratch/Smudge Proof 	<ul style="list-style-type: none"> ➤ Drum Labeling ➤ Electronic Process Labeling – (Circuit Board) ➤ Product ID ➤ Medical ➤ Credit Card



How can you identify a wax, midrange or full resin ribbon from ITW Thermal Films?

Thermal Transfer Ribbons from ITW Thermal Films can be easily identified by the color of the leader (see glossary in back for definition) and the color of the tape holding the leader to the role. Our thermal transfer ribbons are made with a blue leader. The tape colorings are as follows:

FORMULATION	LEADER TAPE COLOR
W90 – Resin Enhanced Wax	Clear
M95 – Midrange - Wax/Resin	Dark Blue
B324 – Premium Resin	Red

Qualifying Questions for the Barcode TTR prospect

It is important to gain an accurate understanding of your customer’s current and future usage patterns for both ribbons and labels. This information includes the following:

Thermal Transfer Ribbons

- What is the current annual/monthly usage of thermal transfer ribbon?
- Who makes decisions regarding thermal transfer ribbon purchases?
- From whom does your company order thermal transfer ribbons?
- Are thermal transfer ribbons and labels/tags ordered together?
- If not ordered together, who buys the label/tag stocks?

- From whom are the label/tag stocks purchased?
- Are there other facilities within the company that use thermal transfer ribbons and labels/tags?
- What is the thermal transfer application?
- What is the application environment?
- What is the print environment?
- What type of information will appear on the label (i.e., barcode, words, etc...)?
- What is the brand and model of the thermal transfer printer?
- What is the length of the ribbon?
- If it is a current application, is the customer using wax, midrange, or resin ribbon?
- What is the label stock being used?
- What is the width of the label/tag stock or ribbon?
 - * It is important to note that *the ribbon must always be at least the same width as the label*; otherwise the label will be in direct contact with the printhead. The resulting friction will wear out the printhead.
- What is your current lead-time?
 - * Stock product from ITW Thermal Films ships the same day the order is placed (if the order is placed by 4p.m EST). Drop shipping is also available.

Additional Thermal Transfer Ribbon hints

Ribbons are manufactured with the ink coated on either the inside of the film carrier or the outside of the film carrier. You will learn that certain printers require coated side in (CSI) ribbons, while others require coated side out (CSO) ribbons. Refer to the following:

- ✓ Coated Side Out (CSO): Zebra, Intermec, Monarch
- ✓ Coated Side In (CSI): Sato, Datamax

Thermal Transfer Labels (Use the following to identify the appropriate label stock)

- What is the brand and model of the thermal transfer printer?
- What is the size of the label (width first, then depth)?
- Do the labels have perforations?
- Are the labels on a roll or fan-folded?
- How many labels per roll?
- What is the maximum outer diameter of the roll?
- What is the core size of the roll?
- What is the winding direction (wind out – copy on outside; wind-in – copy on inside)?
- How will the labels be used?
- Describe the surface that to which the labels will adhere.
- What is the application temperature?
- What are the temperatures that the label will need to withstand (both hot and cold)?
- Will the label need to withstand any other unusual conditions after it is applied?
- Is the surface dry or wet?
- What is the face stock for the application?
- What type of adhesive is required?
- How are the labels applied (hand applied, machine applied)?



Additional Thermal Transfer Label Hints

- It's important to match the application to the appropriate ribbon/label combination. Thermal transfer labels are made from a wide variety of label stocks. They include coated and uncoated face stocks to synthetics like vinyl, polyolefin and polyester. The objective is to match the chemistry of the label to the chemistry of the ribbon formulation so that the proper bonding is achieved.
- When talking with your customer, it is important to gather the appropriate label specifications.
 1. Specify a label by width first and then by depth (i.e., 4" x 6").
 2. Specify the number of rows of labels there are across the width of the label stock.
 3. Identify all perforations, both vertical and horizontal.
 4. Note that the standard space (gap) between labels is .125 (1/8") unless indicated differently

Common Objections

Below are some common objections you will hear as you pursue thermal transfer ribbon opportunities. Following each objection are thoughts to consider as you work to overcome the objection.

Before reading the information below, please review the 1936 U.S. Supreme Court Case, "IBM vs. The United States."

**U.S. Supreme Court
International Business Machines Corp. v. United States, 298
U.S. 131 (1936)**

298 U.S. 131

**International Business Machines Corporation
V.
United States.
No. 758.**

**Argued April 8, 1936.
Decided April 27, 1936.**

1. Section 3 of the Clayton Act, so far as it is applicable to the present case, provides that 'It shall be unlawful for any person engaged in commerce, in the course of such commerce, to lease...machinery...whether patented or unpatented, for use...within the United States...on the condition...that the lessee...[298 U.S. 131, 135] shall not use...supplies or other commodities of a competitor...where the effect of such lease...or such condition...may be to substantially lessen competition or tend to create a monopoly in any line of commerce.' The statute thus in precise terms makes unlawful a condition that the lessee shall not use the supplies or commodities of a competitor of the lesser if the effect of the condition 'may be' to lessen competition substantially, or if it tends to create a monopoly.

IBM leased data processing machines to customers. They required that their customers use only the tabulating cards manufactured by IBM. IBM threatened to terminate their customers' leases if they used cards that were produced by other manufacturers. The U.S. Supreme Court ruled that IBM's lease agreement constituted a "tying agreement" and directly violated the Sherman and Clayton Anti-Trust laws.

The printer warranty will be void unless I use the manufacturer's brand of ribbons.

Thoughts to consider: Printer manufacturers may threaten to void printer warranties if ribbons are bought through another channel. An equipment manufacturer likely cannot require, verbally or in writing, that you buy supplies exclusively from them. If they require this, they may be in violation of the Sherman and Clayton Anti-Trust Acts. They would likely have to conclusively demonstrate and prove that other products are incompatible with their printer in order to have a valid argument.

Printer manufacturers generally offer a 180-day warranty period. If the printheads are properly cleaned, they should last one to two million inches. This is longer than the typical printhead warranty period. If the printhead burns out within the warranty period, the manufacturer or VAR must prove, conclusively, that the cause of the failure is related to the ribbons. This is a long and difficult process with questionable results.

Ask your customer if they would like to explore how much money they would save if they purchased from your company.

My current supplier ties free replacement printheads to my ribbon and label contract.

Thoughts to consider: Today, printheads can cost more than \$400 dollars to replace. But, printheads are never truly free, no matter what you hear! The cost of the printheads is spread throughout the consumables your customer buys. Companies have been known to give away cheap printheads that burn out quickly, and at the same time, charge an unreasonably high price for ribbons and labels to help them come out ahead. In the end, the customer loses. Ask your customer to let you find out how much money you could save them on consumables.

The printer service contract is with the company who supplies the ribbons and labels.

Thoughts to consider: Companies may threaten to pull their service contracts if ribbons are bought through another supplier. It may be illegal for them to require this, either verbally or in writing. Consumers can buy service contracts from approved and non-approved servicing companies. In many cases, only if the contract price was explicitly tied to the agreement to purchase ribbons or other supplies can the contract be terminated.

If this happens, many times they must continue servicing your customer at an adjusted price. Besides, ribbon and label savings will likely exceed the extra costs. Another way to help your cause is to suggest to your customer that they tell their current printer supplier that they have other options and can send their business elsewhere. Printer companies don't want to lose your customers' printer business.

I am happy with my current supplier.

Thoughts to consider: Ask your customer if ribbon availability has ever been a problem? Ask your customer if they ever experience challenges with ribbon/label compatibility?

CALCULATIONS

How Do You Calculate the Number of Rolls of Ribbon that is required for a Specific Label Job?

To determine the number of ribbons needed to print a specific number of labels, follow the steps below:

Metric Conversions to Review before Calculations:

- 25.4mm = 1 inch
- 1 meter = 3.28 feet
- 1 meter = 39.37 inches

1. **Determine the label repeat length.**
Measure from the top of one label to the top of the next label. This measures the label depth plus the gap between the labels. The standard gap is .125" (1/8).
2. **Multiply the label repeat length by the number of labels to be printed.**
3. **Divide the sum by the ribbon roll length in inches.**
*(Note that 1 meter = 39.37 inches)

Example: Customer wants to print 1.5 million 4" x 6" labels on a Zebra 140 XIII printer. The ribbon dimension is 110mm x 450m, or 4.33" x 1,476 feet.

Label Repeat: 6.125" (6" label plus .125" gap)
Number of Labels: 1,500,000
Ribbon Roll Length: 450 meters x 39.37" (inches in a meter)
 = 17,717 inches long
 1,500,000 x 6.125 (repeat) = 9,187,500 inches of label to print

9,187,500 inches divided by 17,717 inches (ribbon length) = **518.57 rolls of ribbon required to print this job. Ribbons are sold in full case quantities so the number of ribbons required to fulfill the order is 528, or 24 cases of ribbons for this size.**

How Do You Determine How Many Labels Can Be Printed with One Roll of Ribbon?

Metric Conversions to Review before Calculations:

- 25.4mm = 1 inch
- 1 meter = 3.28 feet
- 1 meter = 39.37 inches

1. **Determine the ribbon length in inches.**
2. **Determine the label repeat length.**

Example: Customer wants to know how many 3" x 3" labels can be printed from a 410-meter long roll of Sato ribbon.

Ribbon roll length: 410 meters x 39.37 inches/meter = 16,141 inches
Label repeat: 3" label height plus .125" gap, or 3.125" label repeat.
 16,141 roll inches divided by 3.125" (repeat) = **5,165 labels can be printed.**

How Do You Determine the Number of Ribbons Required to Print a Specific Number of Labels or Tags?

Label/Tag Repeat (inches) x # Labels/Tags ÷ Ribbon Length (feet) = # Ribbons

Thermal Transfer Printing Problems & Quality Improvement

Bar Growth



- Print speed too high – Reduce speed
- Old or inferior ribbon media – Replace media
- Use fresh (not older than one year) ribbon; use premium-grade consumables.

Insufficient Print Contrast Signal (PSC) or Light Image



- Print head overheats – Reduce print speed and or print energy
- Faded image - Ribbon and media incompatible
 - Consult supplier for compatible ribbon/media combination.

Unable to Sustain Proper Wide/Narrow Ratio

Under burn (not enough ribbon transfer) - Raise energy setting; use a ribbon with higher sensitivity.



Over burn (too much ribbon transfer) - Reduce energy setting; use a ribbon with lower sensitivity.



Bars too thick - Reduce energy setting; improve ribbon/media quality.



Streaks or "Dead Spots" in Labels



- Wrinkled ribbon
 - Printhead misalignment – Realign printhead
 - Guide bar misalignment – Realign guide bar
 - Adjust printhead pressure
 - Reduce print energy
 - Make sure ribbon width is only slightly wider than label media
 - Adjust rewind tension

Pits and/or Voids, Inconsistent Image Quality



- Dirty print head - Clean print head with Isopropyl alcohol or specialty cleaning solution & cleaning card
- Dust on label media
- Dots missing or worn on print head – Replace printhead

Poor Edge Definition



- Printing too fast – reduce print speed, consider “picket fence” format
- Ribbon and media incompatible - Consult supplier for compatible ribbon/media combination.

Leading and/or Trailing Edges of Image are Translucent ("Ghosting")



- Slew rate to print rate is too high. - Reduce slew rate, one level at a time
- Print head temperature is too low- Increase print head temperature level ("heat factor"), one level at a time.

Additional Considerations

PROBLEM	POSSIBLE CAUSE	SOLUTION
RIBBON SLIPPAGE – KEY SYMPTOM = “GHOSTING” IN NO-IMAGE AREAS	RIBBON IS MOVING AT A SLOWER RATE THAN MEDIA. COMMON TO GLOSSY LABEL STOCKS	ADJUST UNWIND/REWIND TENSION TO 1:1 RATIO, CHANGE LABEL MEDIA
RIBBON OUT SENSOR DOES NOT SHUT DOWN PRINTER	DIRTY SENSOR	CLEAN SENSOR WITH COMPRESSED AIR IF POSSIBLE
RIBBON BREAKING	PRINthead ENERGY IS TOO HIGH	REDUCE ENERGY LEVEL
	PRINthead PRESSURE IS TOO HIGH	ADJUST PRESSURE
	PRINTER SET IN DIRECT THERMAL MODE	SET TO THERMAL TRANSFER MODE
	UNWIND TENSION IS TOO HIGH	REDUCE TENSION
	POOR BACK COAT	CHECK WITH SUPPLIER/REPLACE RIBBON
PRINTER WILL NOT CALIBRATE DIE CUT LABELS	DIRTY SENSOR	CLEAN SENSOR
	PRINTER SET IN CONTINUOUS MODE	SET TO DIE CUT MODE
	LABEL LENGTH UNDER MINIMUM FOR PRINTER MODEL	ATTEMPT 2 UP FORMAT
	SENSOR OUT OF ALIGNMENT	ADJUST SENSOR

Thermal Transfer Glossary

Wax Ribbon - A thermal transfer ribbon that is coated with a wax based ink formulation. Wax ribbons can be manufactured with a hot melt process or a solvent-based process. Wax ribbons are best for coated and uncoated paper stocks. Wax ribbons will print at higher speeds and lower temperatures than midrange or resin ribbons.

Midrange Ribbon - A thermal transfer ribbon that is coated with a combination of wax and resin ink formulations. Midrange ribbons offer more durable print than wax ribbons. They offer superior scratch and abrasion resistance when compared to wax ribbons, but less than that of a full resin ribbon. Midrange ribbons print on paper and synthetic labels.

Resin Ribbon - A thermal transfer ribbon that is manufactured with a pure resin coating. Resin ribbons create the most durable image and they withstand heat and most chemicals. They must image at slower speeds and higher temperatures. Resin ribbons have the highest degree of scratch, smudge and abrasion resistance. The best print results are on synthetic stocks.

Leader Tape - Uncoated film found at the beginning of a roll of ribbon. It is used for product identification and it protects the ribbon from being damaged. Most leaders are colored.

Trailer Tape - Uncoated portion of ribbon found at the end of a thermal transfer ribbon. The trailer sends a signal to the printer that the ribbon is out. Some printers use a silver trailer that uses reflectivity as a sensor. Others use a clear tape, or no tape to the core.

Back coating - coating that provides heat protection, lubrication and static resistance to lengthen printhead life. The back coating comes in direct contact with the printhead.

Core - The fiber/cardboard or plastic cylinder upon which thermal transfer ribbons are mounted. Most cores have a 1" outer diameter.

Core Size - The inner core diameter (I.D.).

Notched Core - Some printers require notches so that the ribbon will fit properly and snap into place.

Take Up Core - Some ribbons are packaged with an extra core to be used to rewind a thermal transfer ribbon after it has been used.

Coated Side In (CSI) - Indicates that the ink is coated on the inside of the ribbon's film carrier. Examples of printers that use CSI ribbons are Fargo/Datamax and Sato.

Coated Side Out (CSO) - Indicates that the ink is coated on the outside of the ribbon's film carrier. Examples of printers that use CSO ribbons are Zebra, Intermec and RJS.

Printhead - Electronic thermal transfer printing element using individually energized matrix wires to transfer the image from the ribbon to a substrate.

IPS (Inches per second) - Stands for inches per second. This stands for the print speeds at which thermal transfer printers image.

Micron - Refers to the thickness measurement that is used to determine the caliper of the thermal transfer ribbon. A micrometer performs the measurement.

OEM - This is an acronym for Original Equipment Manufacturer.

Ribbon Sensor - This is the mechanism on the thermal transfer printer that uses an electronic eye to read the print field area on the label material. Some sensors utilize a gap between labels in order to identify light. Other sensors require a timing mark or a hole punch on the back of the liner.

Burn Temperature - The varying heat settings that transfer the ribbon ink to the face sheet. Some materials require a higher burn setting to transfer the ink.

Ink Melting Point - The temperature in a thermal transfer printer that melts the ribbon ink into the face sheet.

Void - A void refers to the absence of ink in a printing area where ink should appear. Voids create an area of white space that can interfere with the first-read rate of a printed code, and depending on the size and location of the area, may render the code unreadable.

Direct Thermal - A specially coated label material that contains microscopic capsules of ink. The ink capsules burst when exposed to heat.

Clay Coated - Specialized coating that appears on paper label stock. Clay coating optimizes thermal transfer printing.

Bar Code Density - The number of data characters in a bar code, which can be represented in a linear unit of measure. Bar code density is often expressed in characters per inch.

Bar Length - The bar dimension that is perpendicular to the bar width. Bar length is also referred to as height.

Bar Width - The thickness of a bar. It is measured from the edge closest to the symbol start character to the trailing edge of the same bar.

Rotated Bar Code - A bar code symbol where the lines are imaged in the opposite direction as the printing path. This is also referred to as a ladder or a rotated barcode.

First-read Rate - First-read rate is a percentage of how often a code can be read successfully on the first scan.

Print Quality - Print quality is the measure of compliance of a bar code symbol to the requirement of edge roughness, spots, voids, dimensional tolerances, quiet zone, encodation and reflectance.

Printability - Printability refers to surface characteristics on the face stock that relate to printing quality. It is an indication of which face stocks are best for the desired print quality.

Quiet Zone - The quiet zone is the clear space, which contains no marks. The quiet zone precedes the start character of a symbol and follows the stop character.

Abrasion Resistance - Abrasion resistance is the degree to which a label surface resists abrasion.

Haloing - Haloing is when a shadow inadvertently appears around the entire printed image, or around its leading edge. It is caused by excessive pressure on the printing surface.

Ghosting - Ghosting is the indistinct ghost-like images caused by poor ink distribution, label surface inconsistency, ribbon inconsistency or ribbon/label incompatibility.

Feathering - Feathering is a printing defect. It is characterized by uneven, ragged print edges, or by ink spray around the print edges.

MSI – Manufacturing Unit. 1000 square inches

SQM/M2 - Manufacturing Unit. Square Meters.