



Selecting the Right Label to Identify Your Finished Product

Drive business efficiency and realize greater value by ensuring high print quality and durability throughout the product's life



Introduction

Product identification labels are now viewed as a critical mechanism for maintaining compliance, ensuring brand consistency, improving operational efficiency, and supporting business growth. They are the final link between your company and key stakeholders, including customers, consumers, care givers, patients, and regulators.

There are thousands of types of thermal labels, and not all are created equal. Each material features different attributes that enable it to be utilized in different environments. It is critical that the labels you utilize are readable and scannable not only when they leave your operation but throughout the product's safe and appropriate use and disposal. This will reduce your risk of non-compliance with government and industry mandates.

In this paper, Zebra provides guidance on how to select the optimal material to identify your product by reviewing thermal printing basics, identifying the key considerations you need to be mindful of and what to look for in a supplier.



Thermal Printing Basics

Before selecting a label solution, it is important that you understand the differences between direct thermal and thermal transfer printing technologies.

Each method uses a thermal printhead that applies heat to the surface being marked. Thermal transfer printing uses a ribbon to produce durable, long-lasting images on a wide variety of materials. Direct thermal printing does not use a ribbon and instead creates the image directly on the printed material.

Direct Thermal Overview

Direct thermal printing uses chemically treated, heat-sensitive media that blackens when it passes under the thermal printhead. Direct thermal printers have no ink, toner, or ribbon. Direct thermal printing has a shorter life than thermal transfer printing and may fade over time. Direct thermal labels offer minimal resistance to heat, light, abrasion, and chemicals. Exposure to these items will cause the material to darken, resulting in text and barcodes that are unreadable. For these reasons, direct thermal printing is not used for demanding applications.

Thermal Transfer Overview

In thermal transfer printing, a thermal printhead applies heat to a ribbon, which melts ink onto the material to form the image. This technique provides image quality and durability that is unmatched by other on-demand printing technologies.

Thermal transfer works with a wider variety of materials than direct thermal, including paper, polyester, vinyl, polypropylene, and polyimide. Thermal transfer solutions are much more durable than direct thermal, as they are resistant to a wider variety of temperatures and chemicals. To obtain resistance to very demanding environments, the specific label material and ribbon must be carefully matched.

Thermal Transfer Ribbons Overview

By selecting the right material—ribbon combination, as well as specialty adhesives, users can create archival-quality labels to withstand temperature extremes, ultraviolet exposure, chemicals, sterilization, and more. Thermal transfer ribbons are available in wax, wax/resin, and resin formulations that meet the durability requirements of a wide range of labeling applications:

Wax Ribbons	Wax/Resin Ribbons	Resin Ribbons
Designed for applications that use paper facestocks in environments with little to no exposure to weak chemicals and/or exposure to moderate abrasion.	Optimized for use with select paper and matte synthetics in environments with moderate to extreme chemical exposure and/or exposure to moderate abrasion, or where UL/cUL approval is required.	Designed for use with synthetic materials in environments with harsh to extreme chemical exposure and/or exposure to excessive abrasion, and where UL/cUL approval is required.

Key Considerations for Choosing the Right Label Solution

To identify the optimal print technology, material, and ribbon (with thermal transfer printing) to ensure that the label remains readable during the product's safe and appropriate use and disposal, you need to consider the following:

Surface

The type and the shape of the surface being labeled need to be considered to ensure that the label remains adhered to the surface. Have you ever noticed that a specific label does not adhere as well to a plastic bin as it does to a cardboard box? This is because these items have a different surface energy. The shape of the surface is also an important consideration. For example, small curved surfaces are difficult to label, since they require a flexible material with a tight mandrel adhesive to make sure the label does not pull away from the surface.

Extreme Temperatures

Materials and adhesives are also sensitive to very low and very high temperatures. There are two types of temperatures you need to consider, application temperature and service temperature:

- The application temperature is the temperature at which the label is being applied. For example, a new test tube is taken out of a box at room temperature, and a label is applied. The application temperature is 70°F (21°C).
- Service temperature is the temperature range in which the label will be used. For example, the same test tube is filled with a sample and cryogenically stored. Sometime later, it is thawed and sterilized with steam. The service temperature range is -112°F (-80°C) to 212°F (100°C).

Standard materials generally perform well when an application temperature is a minimum of 25°F (-4°C) and when service temperatures range from -65°F (-54°C) to 200°F (93°C). Labeling in conditions outside of this range requires the use of a thermal transfer solution and normally requires a specialty adhesive to ensure that the label remains secured.

Abrasion Resistance

Contact and rubbing will affect readability over time. If in your application, the label will come into contact with items that could scratch it and make it unreadable, a ribbon with a higher resin content will provide improved resistance.

Use of Applicator

If an applicator is to be used, this must be known up front, as the label must be cut differently so that it peels off properly from the liner. In addition, perforations are not recommended because they change the stiffness characteristics of the label, making the label difficult to release from the liner.

Label Solution Considerations

Surface type and shape

Application and service temperatures

Abrasion resistance

Use of applicator

Chemical resistance

Indoor/outdoor needs

Life span of label

Print speed

Print darkness

Dots per inch (DPI)

Key Considerations for Choosing the Right Label Solution

Chemical Resistance

When a label will be exposed to moderate to extreme chemicals, a thermal transfer labeling solution is required. In the case of harsh and extreme chemicals, a high-durability resin ribbon is also recommended. Below is a chart of chemical classifications:

Weak Chemicals	Moderate Chemicals	Harsh Chemicals	Extreme Chemicals
Window Cleaners	Alcohol	Gasoline	Acetone
Water	Bleach	Oil	Xylene

Indoor/Outdoor

If your product will be subjected to outdoor elements (rain, sun, etc.), a thermal transfer synthetic material would be the optimal solution to ensure that both the label and the image have the durability required to survive these tough environmental conditions.

Life Span of Label

In addition to understanding environmental factors, knowing how long the label needs to be readable will help you identify the optimal solution. For example, if the label only requires readability for six months and does not need to resist chemicals, moisture, and abrasion, a direct thermal paper label would best meet your needs. However, if the label will be subjected to moderate chemicals and be on an item that will be stored outside for over three years, a specialty thermal transfer synthetic label would be required.

Print Speed

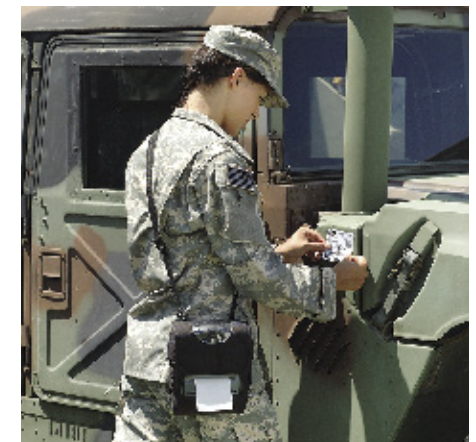
This is a key consideration, as material and ribbon selection will influence the maximum print speed. Typically, synthetic labels do not produce quality text and barcodes above 6 ips, and in order to print at 12 ips or higher, a thermal transfer paper label with a high-speed wax ribbon is required.

Print Darkness

Increasing print darkness is necessary when printing at faster speeds to get the best barcode grades and print quality. When using higher-grade ribbons, which require additional energy, a higher print darkness is also required.

Dots per Inch (DPI)

Using a printer with a higher DPI is necessary when printing formats with detailed graphics and/or small fonts. However, to properly resolve the format, you will also need to use a material with a very smooth or gloss surface, such as a synthetic.



What to Look for in a Supplier

When choosing a thermal printer supplier, be sure to work only with a vendor that has the required certifications for your industry, has quality controls in place, and does not substitute materials from run to run.

Certifications

UL Certified

If you are an electronics manufacturer that UL-lists its products, choose a supplier listed on the UL site that offers label and ribbon solutions that are UL certified. There is a separate UL certification required for suppliers to be able to pre-print the UL mark.

ISO Certified

Suppliers with ISO certifications have standard, consistent procedures and processes in place to ensure that high-quality products are produced.

Quality

- If your application requires the supplier to use pre-printed colored text, symbols, or logos:
 - Make sure that the supplier utilizes an automated color-mixing system that includes color-matching software. This enables the supplier to match your requested PMS color closely and store that formulation within its system so that the color is consistent from run to run.
 - Validate that the supplier has an automated machine vision inspection system on press to ensure proper placement of your pre-printed text throughout the manufacturing process.
- Print quality problems can occur when label rolls have excessive dust. This dust can accumulate on label rolls during the manufacturing process and then accumulate on the printhead, resulting in text and barcode quality issues and increased printhead replacement over time. Therefore, be sure that the supplier has processes in place to sharpen dies on a regular basis and has a trim removal and vacuum system in place to reduce dust.
- No two materials are created equal. That is why it is important that you understand your supplier's materials substitution policy. The use of slightly different materials from run to run can require the adjustment of the print darkness on the printer to enable high-quality images.



Zebra Delivers the Optimal Solution

With more than 1,000 combinations of high-quality and reliable labels, tags, receipt paper, wristbands, and ribbons, Zebra has a media solution for virtually any application.

Supplies R&D Team

With more than 25 years of experience working with thermal print technology, Zebra's Supplies R&D team has unparalleled knowledge of supplies for Zebra printers. With access to all Zebra printers and thousands of different materials, we can find the right material for your application. The Supplies R&D team pre-tests all materials on Zebra printers and conducts additional testing to ensure materials will meet the needs of the application, including:

- Image abrasion and durability
- Accelerated outdoor life
- Adhesion strength on various materials
- Material tear strength
- Temperatures from -112°F/-80°C to 1000°F/538°C
- Harsh chemicals
- Printhead life

The Zebra Supplies R&D team can assist with identifying and testing materials for challenging applications, as well as UL/cUL, CSA, UID, and IMDS approvals.

Zebra's Manufacturing Capabilities

A world-class convertor of labels, tags, receipt paper, and wristbands, Zebra specializes in narrow-web flexographic printing on thermal materials. By making and testing our own printer supplies, we can ensure you receive the highest-quality products, performance-matched to your Zebra printer and application.

- Four U.S. locations, ensuring quick delivery and distribution redundancy for disaster recovery.
- ISO 90001:2008 registered, which ensures that Zebra customers always receive consistent, quality products.
- Extensive manufacturing capabilities, which include laminating, perforations, face and back slits, custom sizes, and color pre-printing.

Zebra's Machine Vision Capabilities

Zebra's barcode sensors, smart cameras, and machine vision software perform label inspections that ensure compliance with regulations and standards set by governing bodies, minimizing potential liability risks and product recalls. In addition to playing a significant role in protecting consumers' health and safety, label inspection also can assist with regulatory compliance, enhanced product quality, and protection of the brand's reputation.

- Zebra's machine vision technology is capable of recognizing label deficiencies such as unclear text or smudging, which could result in product misidentification, confusion, safety hazards, or loss of sales.
- Zebra's optical character recognition (OCR)/optical character verification (OCV) technology examines printed text on labels, guaranteeing the accuracy and legibility of the text and minimizing consumer confusion and potential exposure to health hazards.
- The utilization of OCR/OCV technology in product labeling confirms that the text is complete, precise, and easily readable.

Conclusion

High-quality product identification labels are now viewed as a critical mechanism for maintaining compliance, ensuring brand consistency, improving operational efficiency, and supporting business growth. They are the final link between your company and key stakeholders, including customers, consumers, caregivers, patients, and regulators.

Direct thermal printing, thermal transfer printing, and automated machine vision inspection provide high quality, efficiency, and flexibility for a wide range of label applications. When choosing a thermal printing solution, you can rest confidently knowing that Zebra's selection of label and tag materials meets or exceeds the requirements of most applications and budgets, and that Zebra's machine vision technology ensures every label and tag meets the most stringent quality requirements. Zebra delivers over 100 paper and synthetic label and tag materials, 400 stock ZipShipSM products that are ready to ship, and UL/cUL-approved and CSA-approved materials. Our manufacturing and automated inspection capabilities allow us to produce custom labels and tags of the highest quality, with up to eight colors, in the size and material you require.

For more information about Zebra's industrial machine vision and fixed scanner products, visit: www.zebra.com/us/en/products/industrial-machine-vision-fixed-scanners.html



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