

**PACIFIC  
LABELING**



**COMPARING  
INDUSTRIAL  
CODING, MARKING,  
AND PRINT-AND  
APPLY LABELING**

**T E C H N O L O G I E S**

**A TECHNICAL  
ANALYSIS**



## INTRODUCTION

Industrial manufacturing and packaging require **precise product identification, traceability, and compliance** to meet regulatory standards and enhance supply chain efficiency. Selecting the right **coding, marking, or labeling** technology depends on **substrate type, print durability, resolution, cost-effectiveness, and maintenance needs**.

This white paper provides an **in-depth technical comparison** of the following technologies:

- Thermal Inkjet (TIJ) – Norwix, Squid Ink
- Continuous Inkjet (CIJ) – Leibinger, Squid Ink
- Laser Marking – Squid Ink
- UV LED Curing – Squid Ink
- Print-and-Apply Labeling – Nita Labeling, Label-Aire using SATO and Zebra print engines

Each method is evaluated based on its **technical specifications, ideal applications, advantages, and limitations**, followed by a **comprehensive comparison matrix** for quick reference.

## 1

# DIRECT-TO-PRODUCT CODING & MARKING TECHNOLOGIES

## 1.1 Thermal Inkjet (TIJ) – Norwix, Squid Ink

### How It Works

Thermal Inkjet (TIJ) technology utilizes **micro-resistor heating elements** that generate **heat pulses to vaporize ink**, creating controlled expansion that **forces droplets through microscopic nozzles** onto the substrate. The process allows **high-resolution, sharp-edged characters and barcodes** with **crisp contrast**.

### Technical Specifications

- **Print Resolution:** Up to **600 dpi**
- **Print Speed:** Up to **100 meters per minute**
- **Ink Types:** Water-based, solvent-based, UV-curable inks
- **Drop Volume:** 1–10 picoliters (pl), enabling fine detail printing
- **Nozzle Diameter:** **10–30 µm**, controlling droplet formation
- **Maintenance: Minimal** – Printhead is replaced with each cartridge

### Best Applications

- **High-resolution carton coding** for food, beverage, and industrial goods
- **Pharmaceutical & medical packaging** requiring traceability
- **Logistics & warehousing** (sharp, scannable barcodes)

### Advantages

- ✓ **High-resolution printing** for **barcodes and small text**
- ✓ **Low maintenance** – Printhead is **integrated into each cartridge**
- ✓ **Compact and modular** – Easily integrates into packaging lines

### Disadvantages

- ✗ **Higher ink cost per print** due to **cartridge-based system**
- ✗ **Lower speed** compared to CIJ in **high-volume applications**
- ✗ **Limited adhesion** on non-porous surfaces without specialized inks



Norwix UC22 TIJ  
Case Coder



Squid Ink  
CoPilot TIJ Printer

## 1.2 Continuous Inkjet (CIJ) – Leibinger, Squid Ink

### How It Works

CIJ printers generate a **continuous stream of electrically charged ink droplets** by **applying a high-frequency pulse** to a pressurized ink flow. Charged droplets are deflected by **electrostatic plates**, directing them onto the substrate, while unused ink is recirculated.

### Technical Specifications

- **Print Resolution: 60–300 dpi**
- **Print Speed: Over 300 meters per minute**
- **Ink Types:** Solvent-based, MEK-based, pigmented inks
- **Nozzle Diameter: 40–70 µm**, controlling droplet size
- **Ink Recovery System: Leibinger Sealtronic® prevents nozzle drying**

### Best Applications

- **Beverage & food packaging** (bottles, cans, flexible packaging)
- **Extrusion marking** (cables, pipes, and automotive parts)
- **Pharmaceutical compliance coding** (expiration dates, batch numbers)

### Advantages

- ✓ **High-speed printing**, even on **irregular and curved surfaces**
- ✓ **Compatible with non-porous substrates** (glass, plastic, metal)
- ✓ **Self-cleaning printheads** (Leibinger's Sealtronic® technology)

### Disadvantages

- ✗ **Requires solvent-based ink management**
- ✗ **Lower resolution** than TIJ – not ideal for **high-detail barcodes**
- ✗ **Higher maintenance requirements** due to **ink recirculation system**



LEIBINGER IQ Jet CIJ Printer



Squid Ink JetStream CIJ Printer

## 1.3 Laser Marking – Squid Ink

### How It Works

Laser marking **modifies the material surface** using a **focused, high-intensity laser beam**, which **vaporizes, ablates, or induces a chemical color change** to create permanent marks.

### Technical Specifications

- **Laser Types:** CO<sub>2</sub>, Fiber, UV
- **Marking Speed:** Up to 2,000 characters per second
- **Resolution:** Up to 1,000 dpi
- **Substrates:** Metals, plastics, glass, ceramics
- **Maintenance:** Minimal, as no consumables are needed

### Best Applications

- Automotive, aerospace, and medical device part marking
- Counterfeit prevention in high-value products
- Food & beverage (permanent expiration date marking on glass bottles)

### Advantages

- ✓ Permanent, tamper-proof markings
- ✓ No ink, solvents, or consumables
- ✓ High-speed, non-contact operation

### Disadvantages

- ✗ High initial investment
- ✗ Not suitable for heat-sensitive substrates
- ✗ Requires fume extraction for plastics



Squid SQ-30  
CO<sub>2</sub> Laser Coding System

## 1.4 UV LED Curing – Squid Ink

### How It Works

UV LED curing **instantly cures UV-reactive ink** upon exposure to **ultraviolet light**, resulting in **immediate bonding to non-porous surfaces**.

### Technical Specifications

- **Print Resolution: Up to 1,200 dpi**
- **Print Speed: Up to 200 meters per minute**
- **Ink Type:** UV-curable ink
- **Substrates:** Coated cartons, plastic, flexible packaging, and glass
- **Maintenance: Minimal**, as UV ink does not dry in the printhead

### Best Applications

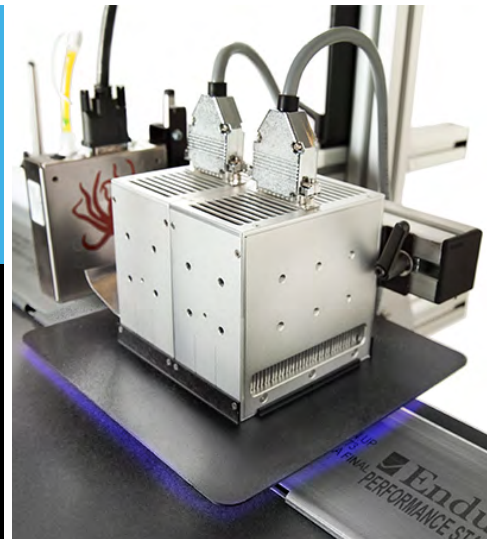
- **Luxury packaging & cosmetics**
- **Food-grade applications with low-migration inks**
- **Durable branding on plastics and glass**

### Advantages

- ✓ Immediate drying with high contrast
- ✓ Superior adhesion on non-porous surfaces
- ✓ Eco-friendly, emitting low VOCs

### Disadvantages

- ✗ Higher cost of UV-curable inks
- ✗ Requires UV LED curing lamps, increasing power consumption
- ✗ Limited to UV-reactive materials



Squid UV LED Curing System

## 2 PRINT-AND-APPLY LABELING – NITA LABELING & LABEL-AIRE

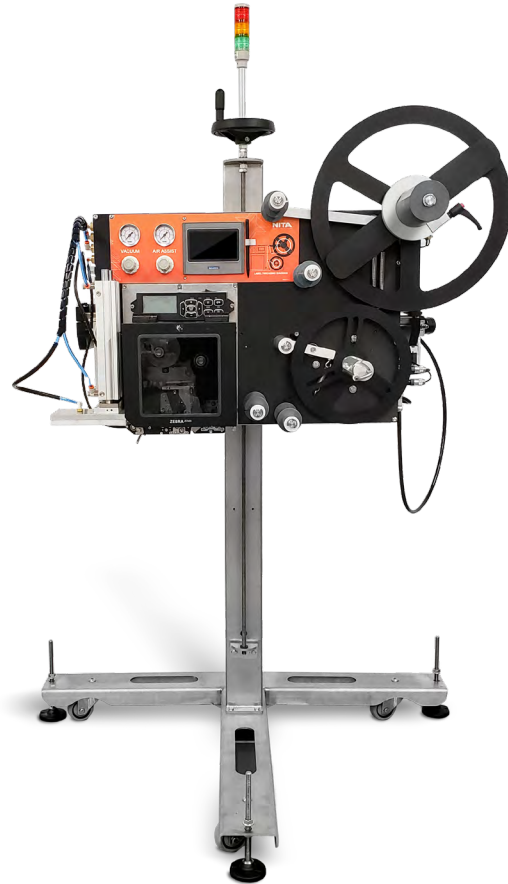
### *Technical Overview of Print-and-Apply Labeling*

Print-and-apply labeling systems are essential for automating product identification, packaging, and compliance labeling. These systems combine thermal printing and automatic label application into a single integrated unit, typically used for applying pressure-sensitive labels to products, cartons, or pallets at high speed and with consistent accuracy.

Two of the most widely adopted print engines in these systems are Zebra and SATO, both known for their rugged design, precise printing, and seamless integration into industrial environments.

### *How It Works*

At the core of a print-and-apply system is the thermal print engine (Zebra or SATO), which prints variable data—such as barcodes, batch numbers, lot codes, and shipping details—directly onto a pressure-sensitive label using thermal transfer or direct thermal technology. Once printed, the label is automatically dispensed and applied to the product via an applicator system that may use a tamp, blow, wipe, or swing-arm mechanism depending on the application.



*Nita Labeling P&A - STA-616 Print-And-Apply Labeler*

## 2.1

| Factor                  | TIJ                  | CIJ                 | Laser                 | UV LED Curing      | Print-and-Apply       |
|-------------------------|----------------------|---------------------|-----------------------|--------------------|-----------------------|
| <b>Print Resolution</b> | Up to 600 dpi        | 60–300 dpi          | Permanent             | 1,200 dpi          | 600 dpi               |
| <b>Print Speed</b>      | Moderate             | High                | High                  | High               | Moderate              |
| <b>Substrates</b>       | Porous & semi-porous | Porous & non-porous | Metal, plastic, glass | Glossy, non-porous | Any material (labels) |
| <b>Consumables</b>      | Ink cartridges       | Ink & solvents      | None                  | UV-reactive ink    | Labels, ribbons       |
| <b>Maintenance</b>      | Low                  | Moderate            | None                  | Low                | Low (printhead wear)  |
| <b>Cost</b>             | Low upfront          | Higher upfront      | High upfront          | Higher upfront     | Moderate              |



SATO S8486NX Print Engine



Zebra ZE511 Print Engine



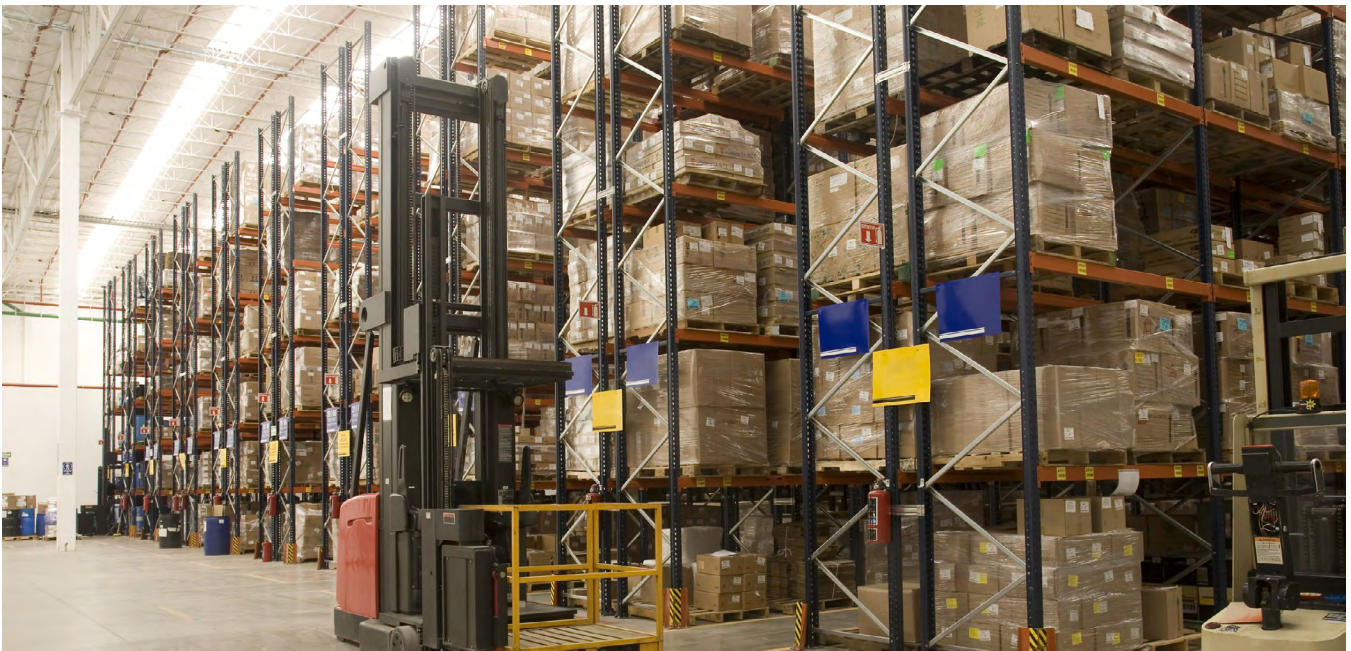
## 3

## CONCLUSION: EXPERT SOLUTIONS FROM PACIFIC LABELING & INTEGRATION

Choosing the right coding, marking, or labeling technology is critical to ensuring **production efficiency, regulatory compliance, and long-term cost-effectiveness**. Each method has its own strengths and trade-offs, making it essential to work with experts who understand both the **technical specifications and real-world applications** of these solutions.

At **Pacific Labeling & Integration**, we don't just sell equipment—we provide **comprehensive, end-to-end solutions** tailored to your operation's needs. From **initial system selection and integration** to **ongoing maintenance and technical support**, we ensure that your **marking and labeling systems run smoothly with minimal downtime**. Our team of **industry experts, factory-trained technicians, and responsive support staff** is dedicated to keeping your production lines moving with **reliable service, rapid troubleshooting, and expert guidance**.

With decades of experience in **industrial marking, coding, and labeling**, Pacific Labeling & Integration is your **trusted partner** in achieving **consistent, high-quality product identification and traceability**. Whether you need a **high-speed marking system for a demanding production line** or a **precisely engineered labeling solution for complex packaging**, we are committed to delivering **unmatched reliability, service, and expertise**—because your business depends on it.



# PACIFIC LABELING & INTEGRATION

**CONTACT US TODAY TO DISCUSS  
HOW WE CAN HELP OPTIMIZE  
YOUR CODING, MARKING, AND  
LABELING OPERATIONS!**

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