Technology White Paper

How to Select the Best Direct Marking Method for Your Part

Overview of Direct Part Marking Solutions for Various Applications

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How to Select the Best Direct Marking Method for Your Part

This white paper outlines direct part marking solutions for various applications. Each marking method has its advantages and limitations, and choosing the right method for your part can have a great impact on part quality and production efficiency. Topics of this paper include:

- *Marking Methods Overview*
- *Advantages, Disadvantages and Applications of Particular Methods*
- *Reading Direct Part Marks*

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While the overall concept of product tracking is not new, the automated tracking of products down to the individual part and component level has proven to have great bottom-line impact. The most direct way to ensure complete quality control of the production process is to mark objects with a machine-readable symbols and track them through the entire life cycle.

Many Marking Methods Are Available

There are many methods to directly mark objects. Selecting the best method for the application is critical to achieving success. Since each method has its own advantages and limitations, it is important to review and experiment with as many methods as possible before selecting the appropriate one.

Electrochemical Etch:
This process uses a low voltage current to mark the object surface. Unlike other permanent marking methods, electro-chemical etching does not weaken or distort metal parts because the molecular structure of the part is not altered beyond the depth of the mark. Since electro-chem- ical etching is a more involved process than other methods, it is not suited for highly automated applications and is commonly used for low volume product runs.

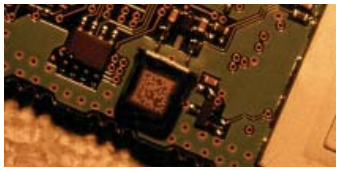
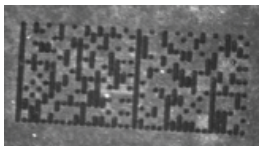
Ink Jet:
This type of marking uses small, dots sprayed directly onto the surface of the part. Ink jet typically produces high contrast marks, depending on the substrate and the ink color. Although permanent inks do exist, ink jet is not considered by some industry standards as a permanent marking method.

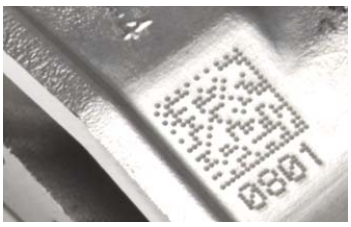
Laser Etch:
This marking type uses lasers to etch the symbol directly into the surface of the part. In addition to producing a clean, high resolution mark on a variety of substrates ranging from metal to plastics to glass, laser-etching is also well-suited for automated environments requiring high volumes. While laser etching equipment has a higher entry cost than many marking methods, there is no additional cost of consumables and maintenance is minimal.

Dot Peen:
Dot Peen is a percussive marking method, using changes in depth to create the contrast between the light and dark elements of the symbol. Dot peen is recommended for applications where the symbol must last the entire life cycle of the part. In the aerospace and automotive industries, this can be several years. Suitable substrates for dot peen marking must have some hardness so
material memory does not return the surface to its original condition.

On the following pages, a wide range of marking methods are discussed, including advantages and disadvantages.

Marking Method	Description	Advantages & Disadvantages
Ink Jet on ABS plastic 	Contrast levels vary widely, round element shape ***Application:*** - Post-packaging - Warehousing - Automotive	***Advantage:*** - Low-entry cost - High speed - Easy to read if contrast is good ***Disadvantage:*** - Not considered permanent by some industry standards - Dot registration can vary - Higher cost consumables - Mark quality dependant on surface cleanliness - Difficult to read if contrast poor
Pre-printed packaging 	Typically high contrast, square element shape ***Application:*** - Product labeling - Product packaging - Document processing	***Advantage:*** - Economical - High speed - Good contrast - Easy to read ***Disadvantage:*** - Less flexibility
Thermal transfer label stock 	High contrast, typically black on white label stock, square element shape ***Application:*** - Product labeling - Packaging - WIP tracking, various industries	***Advantage:*** - High contrast - Low-entry cost - Easy to read ***Disadvantage:*** - Not permanent - Higher cost due to consumables
Laser etch on silk screen 	High contrast, square & round element shape ***Application:*** - Electronics	***Advantage:*** - Good contrast - No consumables - Permanent ***Disadvantage:*** - Displaces surface - Process creates debris
Ink jet on plastic 	High or low contrast, round element shape ***Application:*** - Bio-science - Pharmaceuticals - Packaging	***Advantage:*** - Limited damage to surface ***Disadvantage:*** - Higher cost due to consumables - Not permanent - Bleeding can affect mark quality

Marking Method	Description	Advantages & Disadvantages
Thermal print on foil packaging 	Typically good contrast, square element shape ***Application:*** - Pharmaceutical Packaging	***Advantage:*** - Economical ***Disadvantage:*** - Reflective nature of marking method may require additional lighting - Deformation of surface may affect readability of code
Ink jet on glass 	Good contrast, round element shape ***Application:*** - Pharmaceutical Packaging - Clinical R&D - Electronics	***Advantage:*** - High contrast - Low entry cost - Limited damage to surface ***Disadvantage:*** - Not permanent - Bleeding can affect mark quality
Laser etch on metal 	Low contrast, square element shape ***Application:*** - Electronics - Automotive - Aerospace - DOD - Medical device	***Advantage:*** - Permanent - No consumables - High quality mark ***Disadvantage:*** - Process creates debris - Affects surface of substrate
Laser etch on glass epoxy 	Medium contrast, square element shape ***Application:*** - Electronics	***Advantage:*** - Permanent - No consumables - High quality mark ***Disadvantage:*** - Process creates debris - Lack of contrast; difficult to read - Affects surface of substrate
Chem etch on metal 	Typically medium contrast, square element shape ***Application:*** - Electronics - Semiconductor - DOD - Aerospace - Medical device	***Advantage:*** - Permanent - High quality mark - No debris from process ***Disadvantage:*** - Potentially toxic material by-product - Low-volume use only
Laser etch on rubber 	Very low contrast, square or round element shape ***Application:*** - Automotive	***Advantage:*** - Permanent - No consumables ***Disadvantage:*** - Process creates debris - Affects surface of substrate

Marking Method	Description	Advantages & Disadvantages
Chem etch on silicon 	Typically medium contrast, square element shape ***Application:*** - Semiconductor	***Advantage:*** - Permanent - High quality mark - No debris from process ***Disadvantage:*** - Potentially toxic material byproduct - Potentially complex process
Dot peen on smooth, highly reflective metal 	Low contrast, dependant on difference in depth to create light and dark elements. Round or square element shape, dependant on shape of stylus ***Application:*** - Automotive - Aerospace - DOD	***Advantage:*** - Permanent - No consumables ***Disadvantage:*** - Alters surface - Low contrast mark - More difficult to read - Inconsistent depth will create smaller elements - Background noise
Dot peen on machined metal 	Low contrast, dependant on difference in depth to create light and dark elements. Round or square element shape, dependant on shape of stylus ***Application:*** - Automotive - Aerospace - DOD	***Advantage:*** - Permanent - No consumables ***Disadvantage:*** - Alters surface - Low contrast mark - Very difficult to read, due to high degree of surface noise created by texture

Reading Direct Part Marks

Microscan's Hawk family of imagers and verifiers are designed with specialized illumination and decode algorithms to read challenging direct part marks created by any method on any material. All Hawk DPM imagers include the latest DPM decoding technology, and user-friendly features such as one touch setup/decoding, laser targeting and real-time feedback.

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