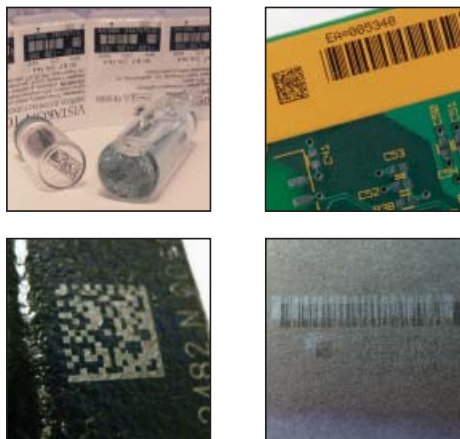


Review and Selection of Direct Part Marking Methods

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.



Assessing Your Application

Since each application is at least somewhat unique, you should know the answers to the following questions before selecting a marking method: what type and how much data will you need to encode, how much real estate is available for the symbol, is symbol permanency a concern and who will be using the information.

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. Each method has its own advantages and limitations. 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 best one for your application.



Electrochemical Etch: This process uses a low voltage current to mark the object surface. This is commonly used for low volume product runs.






Ink Jet: This type of marking uses small, dots sprayed directly onto the surface. Ink jet produces high contrast marks. Ink jet is not considered a permanent marking method.




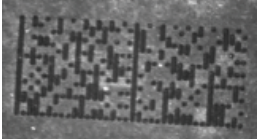
Laser Etch: Lasers etch the symbol directly onto a surface. Clean, high resolution marks are produced making laser-etch well-suited for automated environments.

Dot Peen: Dot peen is a percussive marking method, using changes in depth to create marks. Dot peen is recommended for applications where the symbol must last the entire life cycle.

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

Marking Method	Description	Advantages & Disadvantages
Ink Jet on substrate 	<p>Contrast levels vary widely, round element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Post-packaging - Warehousing - Automotive 	<p>Advantage:</p> <ul style="list-style-type: none"> - Low-entry cost - High speed - Easy to read if contrast is good <p>Disadvantage:</p> <ul style="list-style-type: none"> - 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 	<p>Typically high contrast, square element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Product labeling - Product packaging - Document processing 	<p>Advantage:</p> <ul style="list-style-type: none"> - Economical - High speed - Good contrast - Easy to read <p>Disadvantage:</p> <ul style="list-style-type: none"> - Less flexibility
Thermal transfer label stock 	<p>High contrast, typically black on white label stock, square element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Product labeling - Packaging - WIP tracking, various industries 	<p>Advantage:</p> <ul style="list-style-type: none"> - High contrast - Low-entry cost - Easy to read <p>Disadvantage:</p> <ul style="list-style-type: none"> - Not permanent - Higher cost: consumables
Laser etch on silk screen 	<p>High contrast, square & round element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Electronics 	<p>Advantage:</p> <ul style="list-style-type: none"> - Good contrast - No consumables - Permanent <p>Disadvantage:</p> <ul style="list-style-type: none"> - Displaces surface - Process creates debris
Ink jet on plastic 	<p>High or low contrast, round element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Bio-science - Pharmaceuticals - Packaging 	<p>Advantage:</p> <ul style="list-style-type: none"> - Limited damage to surface <p>Disadvantage:</p> <ul style="list-style-type: none"> - Higher cost consumables - Not permanent - Bleeding can affect mark quality

Marking Method	Description	Advantages & Disadvantages
Thermal print on foil packaging 	<p>Typically good contrast, square element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Pharmaceutical Packaging 	<p>Advantage:</p> <ul style="list-style-type: none"> - Economical <p>Disadvantage:</p> <ul style="list-style-type: none"> - Reflective nature of marking method may require additional lighting - Deformation of surface may affect readability of code
Ink jet on glass 	<p>Good contrast, round element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Pharmaceutical Packaging - Clinical R&D - Electronics 	<p>Advantage:</p> <ul style="list-style-type: none"> - High contrast - Low entry cost - Limited damage to surface <p>Disadvantage:</p> <ul style="list-style-type: none"> - Not permanent - Bleeding can affect mark quality
Laser etch on metal 	<p>Low contrast, square element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Electronics - Automotive - Aerospace - DOD - Medical device 	<p>Advantage:</p> <ul style="list-style-type: none"> - Permanent - No consumables - High quality mark <p>Disadvantage:</p> <ul style="list-style-type: none"> - Process creates debris - Affects surface of substrate
Laser etch on glass epoxy 	<p>Medium contrast, square element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Electronics 	<p>Advantage:</p> <ul style="list-style-type: none"> - Permanent - No consumables - High quality mark <p>Disadvantage:</p> <ul style="list-style-type: none"> - Process creates debris - Lack of contrast; difficult to read - Affects surface of substrate
Chem etch on metal 	<p>Typically medium contrast, square element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Electronics - Semiconductor - DOD - Aerospace - Medical device 	<p>Advantage:</p> <ul style="list-style-type: none"> - Permanent - High quality mark - No debris from process <p>Disadvantage:</p> <ul style="list-style-type: none"> - Potentially toxic material byproduct - Low-volume use only

Marking Method	Description	Advantages & Disadvantages
Chem etch on silicon 	<p>Typically medium contrast, square element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Semiconductor 	<p>Advantage:</p> <ul style="list-style-type: none"> - Permanent - High quality mark - No debris from process <p>Disadvantage:</p> <ul style="list-style-type: none"> - Potentially toxic material byproduct - Potentially complex process
Dot peen on smooth, highly reflective metal 	<p>Low contrast, dependant on difference in depth to create light and dark elements. Round or square element shape, dependant on shape of stylus</p> <p>Application:</p> <ul style="list-style-type: none"> - Automotive - Aerospace - DOD 	<p>Advantage:</p> <ul style="list-style-type: none"> - Permanent - No consumables <p>Disadvantage:</p> <ul style="list-style-type: none"> - Alters surface - Low contrast mark - More difficult to read - Inconsistent depth will create smaller elements - Background noise
Dot peen on textured metal 	<p>Low contrast, dependant on difference in depth to create light and dark elements. Round or square element shape, dependant on shape of stylus</p> <p>Application:</p> <ul style="list-style-type: none"> - Automotive - Aerospace - DOD 	<p>Advantage:</p> <ul style="list-style-type: none"> - Permanent - No consumables <p>Disadvantage:</p> <ul style="list-style-type: none"> - Alters surface - Low contrast mark - Very difficult to read, due to high degree of surface noise created by texture
Laser etch on rubber 	<p>Very low contrast, square or round element shape</p> <p>Application:</p> <ul style="list-style-type: none"> - Automotive 	<p>Advantage:</p> <ul style="list-style-type: none"> - Permanent - No consumables <p>Disadvantage:</p> <ul style="list-style-type: none"> - Process creates debris - Affects surface of substrate

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