

# MARKING & DECODING 2D SYMBOLOLOGIES

# About Your Instructors



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With Microscan since 1996

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Joined Microscan in 1999

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# Today's Objectives

## By the end of today's Webinar, you will know

- Proper marking techniques for your application & maximizing readability
- Different marking methods available
- How a 2D symbol is decoded

# Today's Topics

- Selecting a Symbology
- Marking Methods
- Decoding a 2D Symbol
- Maximizing Readability
- Decodability



# Selecting a Symbology

## Select a Symbology

- Many things to consider:
  - Space, surface shape & quality
  - Amount of data
  - Cost of equipment (printer type, scanner vs. imager, consumables)
  - Cosmetic, product appearance
  - Type of equipment down the supply chain
- Some applications may only require a laser scanner
  - Good contrast, non-reflective material, flat surface
- Data Matrix is more common for DPM
  - Easy to make with many marking methods
  - Easy to decode on different substrates
  - Error correction recovers from misprints and damage



Some DPM marks can be decoded with a laser scanner

# Marking Methods

## Print

Inkjet, laser, thermal printers onto labels and paper

- Most commonly used
- This can be done with standard office printers
- Marks are fragile and temporary

### **Advantage:**

- Supplies are readily available
- Simple and fast to make
- High quality/contrast

### **Disadvantage:**

- Fragile
- Consumables



### **Applications**

- Warehousing
- Packaging
- Pharmaceutical

# Marking Methods

## Electrochemical (chem etch)

Electrical current passes through a stencil into the conductive metal part

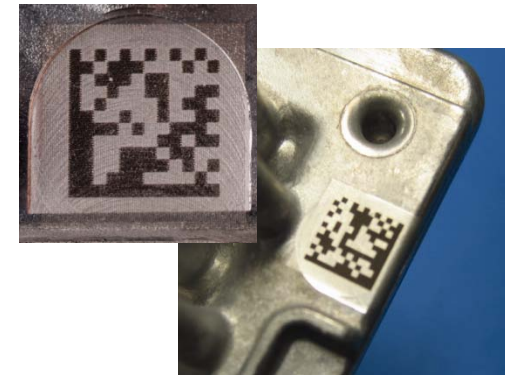
- Material is not weakened or distorted
- Good for thin or fragile material
- Can produce toxic fumes

### **Advantage:**

- *Permanent*
- *High quality mark*
- *No debris from process*

### **Disadvantage:**

- *Potentially toxic material bi-product*
- *Low-volume use*
- *Complex process*



### **Applications**

- *Military*
- *Aerospace*
- *Medical device*



# Marking Methods

## Direct Ink Jet

An ink is applied by spray nozzles, typically resulting in round dots

- Food grade inks
- Quality and contrast varies
- Print on difficult shapes

### **Advantage:**

- *High contrast if done right*
- *Low entry cost*
- *No damage to part surface*
- *High speed printing*

### **Disadvantage:**

- *Temporary in most cases*
- *Easy to make a poor print*
- *Contrast varies*
- *Consumables (ink)*



### **Applications**

- Post-packaging
- Warehousing
- Automotive
- Bio-science
- Pharmaceuticals
- Packaging
- Clinical R&D
- Electronics

# Marking Methods

## Laser Etch: Anneal, Ablation

Laser is used to cut away a thin layer of surface material.

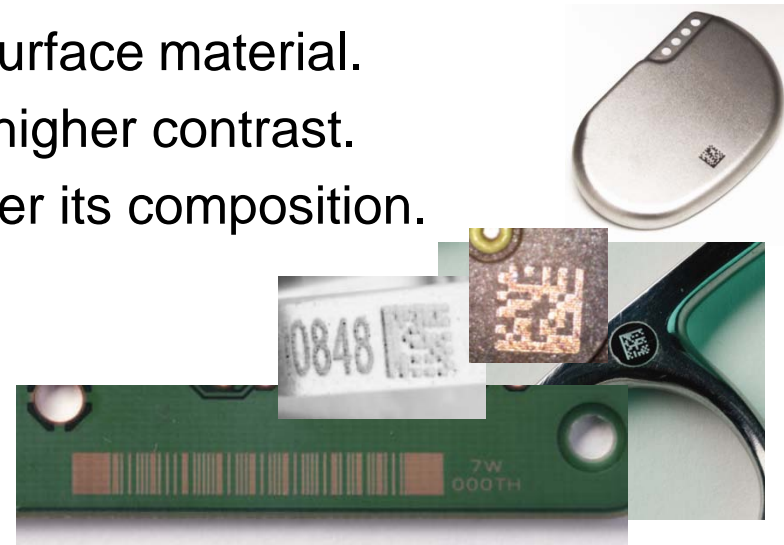
- Ablation exposes another material for higher contrast.
- Anneal heats a Materials surface to alter its composition.

### **Advantage:**

- Clean, high resolution
- Can be high contrast
- Permanent (if not using labels)
- No consumables (if not using labels)
- Does not alter part surface (anneal)

### **Disadvantage:**

- Possible consumables (if using labels)
- Affects surface integrity
- Process creates debris



### **Applications**

- Aerospace
- Military
- Automotive
- Electronics
- Surgical tools
- Medical Implants

# Marking Methods

## Dot Peen

A multi-axis pointed stylus hits a part like a hammer, which displaces material, leaving a dimple in its place

- Typically used on metals
- Recommended for automotive and aerospace where the marks must last the life of the part

### **Advantage:**

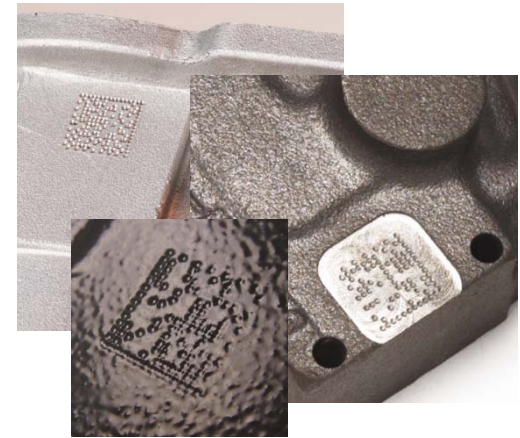
- *Permanent*
- *No consumables*

### **Disadvantage:**

- *Alters surface*
- *Low contrast mark*
- *More difficult to read*
- *Inconsistent depth will create smaller elements*
- *Background noise*

### **Applications**

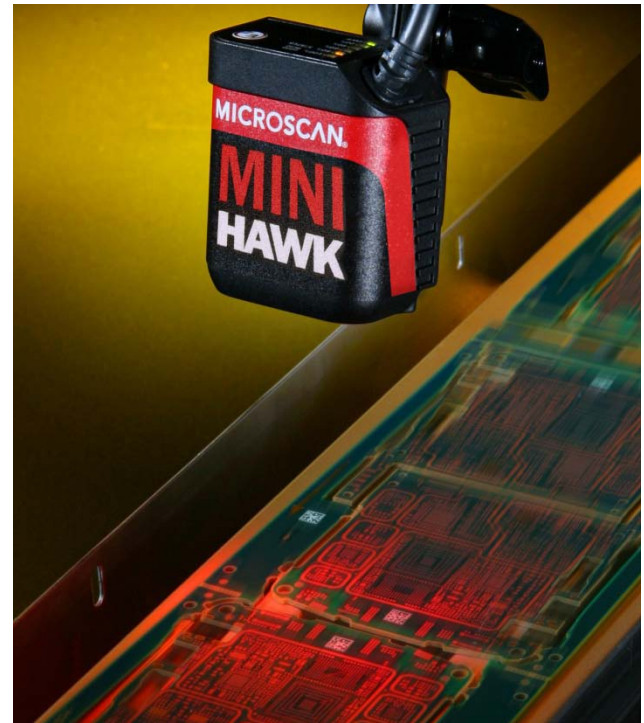
- Automotive
- Aerospace
- Military





# Capture an Image

- A light source is used to illuminate the part
- A sensor captures the reflected light and converts to a digital image
- Software is used to decode the image



# Decoding a 2D Symbol

Decoding consists of two parts:

## Locate

- Decoder must locate the symbol within the image using unique traits to each symbology
- A higher resolution sensor will take longer to locate
- It will take longer to locate a symbol in a noisy field of view

## Decode

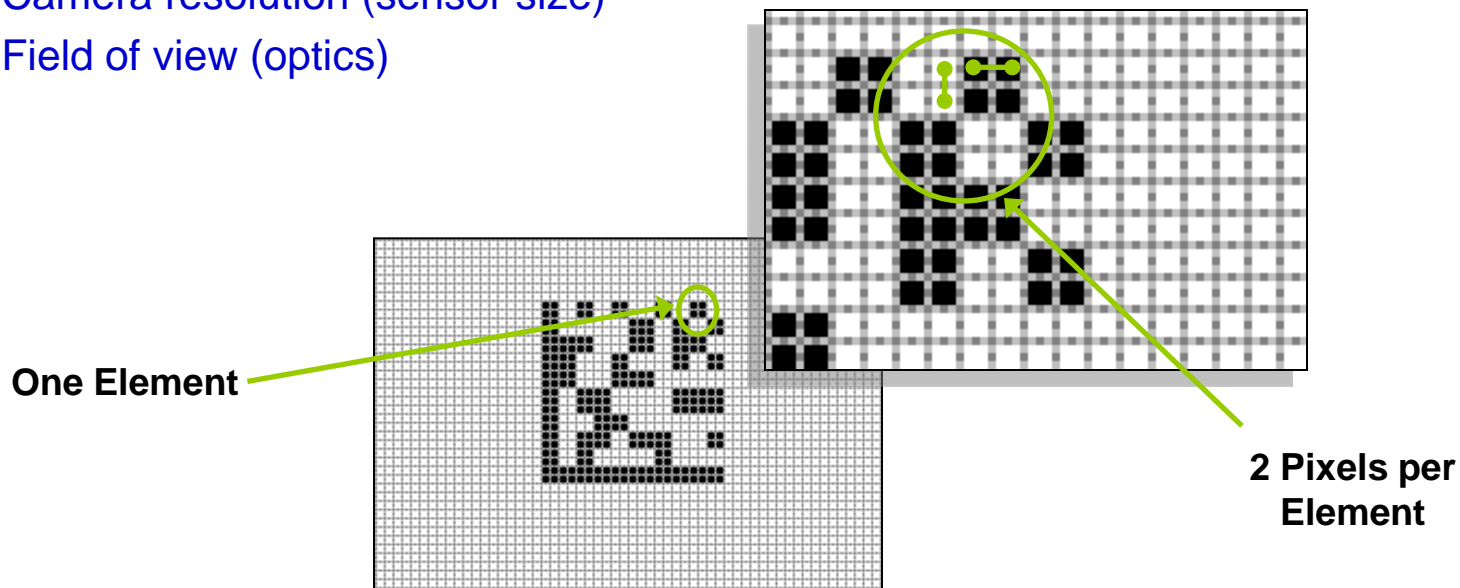
- Decoding algorithms are unique to the products you are using
- When a decoder is configured to look for several symbologies, decode time will be longer
- A minimum number of Pixels Per Element (PPE) will ensure consistent decodes



# Decoding a 2D Symbol

## Pixels Per Element (PPE)

- The number of pixels that cover an element in either the X or Y dimension.
- The number of Pixels Per Element is determined by:
  - Symbol size (size of the elements)
  - Camera resolution (sensor size)
  - Field of view (optics)

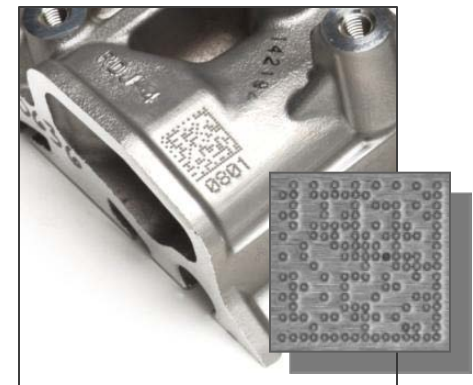


Microscan's read range tables have this calculated for you.

# Maximizing Readability

Consider the following when designing a code:

- Contrast: maximize the difference between white and black elements
  - Easier to read
  - No special lighting or algorithms
- Quiet Zone: increase the Quiet Zone to improve decode speeds
- Element size: the larger the better for DPM
  - Overcome surface texture (DPM)
  - More versatile with reading equipment
- Quality: good codes decode more reliable
  - Damaged codes use error correction
  - Improperly marked codes reduce contrast
- Mark position: choose a smooth flat location
  - Avoid curved or bumpy surfaces if possible
  - Position where it is accessible by a reader



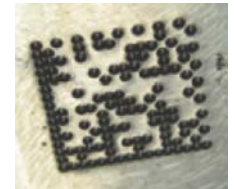
A nicely printed Dot Peen  
can be easy to read



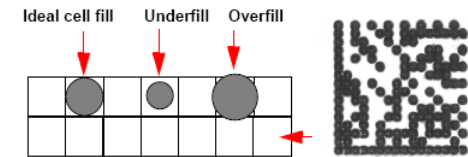
# Decodability

## Common problems with Direct Part Marks

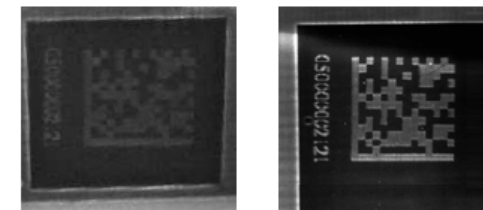
- Dot center offset
  - The elements do not have a consistent placement
- Cell fill
  - The percentage that an element fills its ideal size
  - Slight underfill is typically more readable than overfill
- Contrast
  - Low contrast can be a problem on DPMs
  - Adjust the imager and lighting angles to optimize



Dot center offset



Cell fill



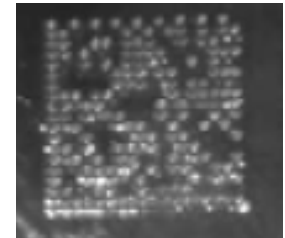
Contrast

The best solution:  
***Fix the code!***

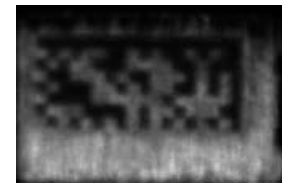
# Decodability

## Common problems with Direct Part Marks

- Modulation
  - Uneven printing or illumination can make it difficult to read a code
  - Adjust the imager and lighting angles to optimize
- Quiet Zone (Margin) violations
  - A poor Quiet Zone may make it hard to locate a code



Modulation



Poor quiet zone

## *Verification prevents these errors*



### Verifiers

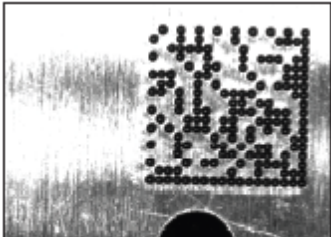
Microscan's LDP and DPM Verifiers provide complete reports to current Data Matrix verification standards for printed and Direct Part Marks.

ISO/IEC 16022 • ISO/IEC 15415 • AS9132 • AIM DPM Guidelines • MIL-STD-130

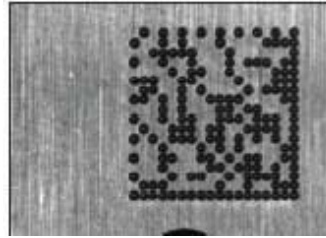
# Decodability

## Example images on Direct Part Marks

Before

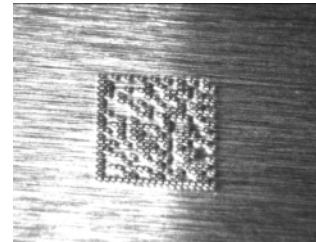


After

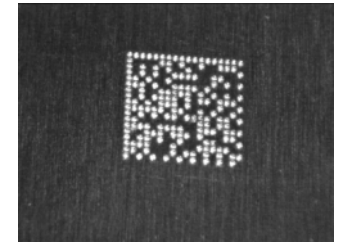


Effect of shiny surface: use diffuser

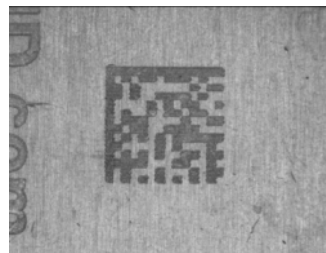
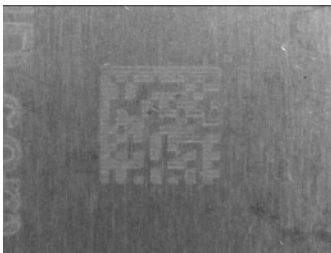
Before



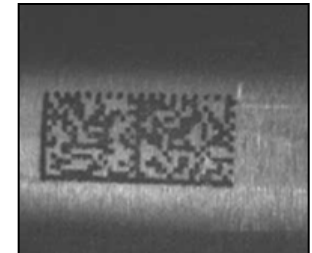
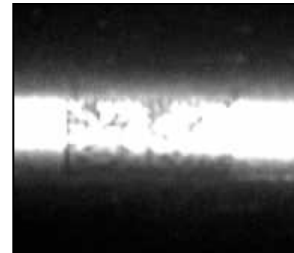
After



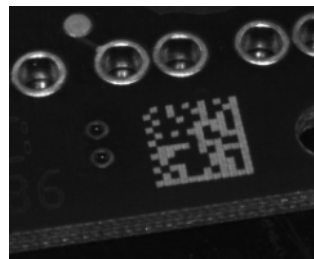
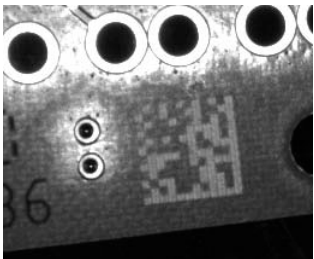
Effect of surface structure: rotate 90°



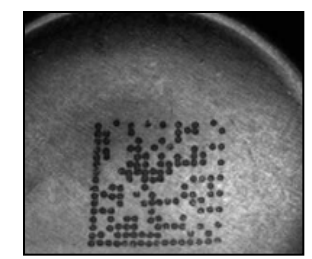
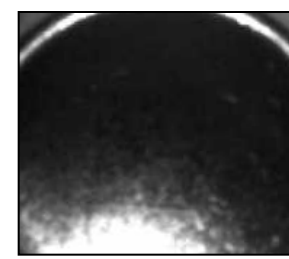
Effect of low contrast: change reading angle



Effect of curved surface: use external line light



Effect of reading angle: change reading angle



Effect of concave surface: use dome light

# Marking & Decoding 2D Symbologies

## Conclusion

- Marking Methods
  - Printed
  - Chem Etch
  - Direct Ink Jet
  - Laser Anneal, Ablation, Etch
  - Dot Peen
- Decoding a 2D symbology
  - Locate, and then decode
  - Minimum resolution (PPE)
- Maximizing Readability and Decodability
  - Making a better image will improve reliability

# Next session....

## **Applications and technology:**

- Data Matrix applications in vertical markets
- Reading technology for applications

# Thank you!

## For More information

Website: [www.microscan.com](http://www.microscan.com)

- Online courses
- Spec sheets
- Technology brochures
- Support self-help and support request form

Webinar feedback: [www.microscan.com/feedback](http://www.microscan.com/feedback)

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