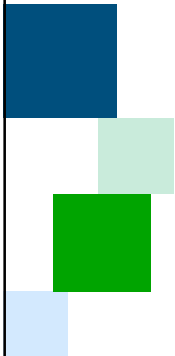



## Printing technologies for Data Matrix Codes


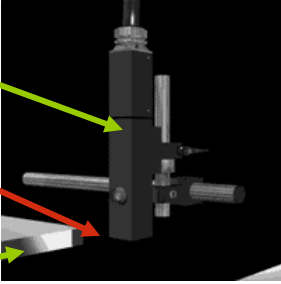
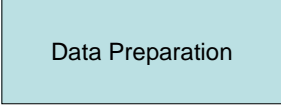
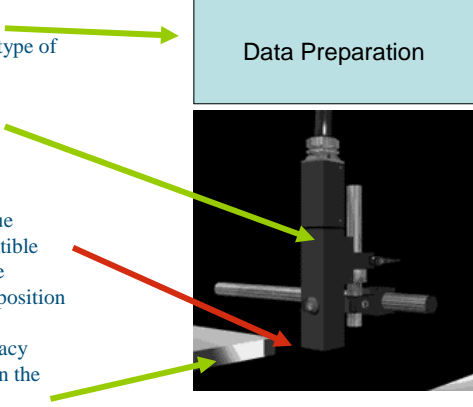
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Lee Metters  
December 2007



## What makes a successful application?

- Data Preparation
  - Appropriate for type of application
- Printer
  - Print accuracy
  - Print speed
  - Consistency
  - Throw distance
- Ink/Marking technique
  - Substrate compatible
  - Colour, Dry time
  - Acceptable composition
- Mechanical handling
  - Speed and accuracy
- All parts must work in the environment
- Accredited
- With Camera verification



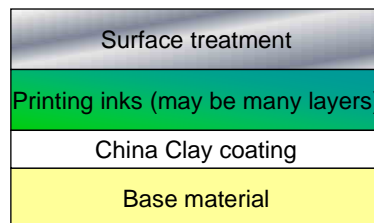
## The VITAL questions to select your coding technology

- What am I coding on?
- Where am I coding?
- What has it got to withstand afterwards
- What is the coding format?



## What am I printing on?

- Different technologies suit different materials
- Plastics, metals and paper all different
- Some marking techniques sit on the surface, others affect lower layers
  - Surface coating have significant effects
- Its not always possible to change the material
  - Suppliers may use different materials between batches



## Movement

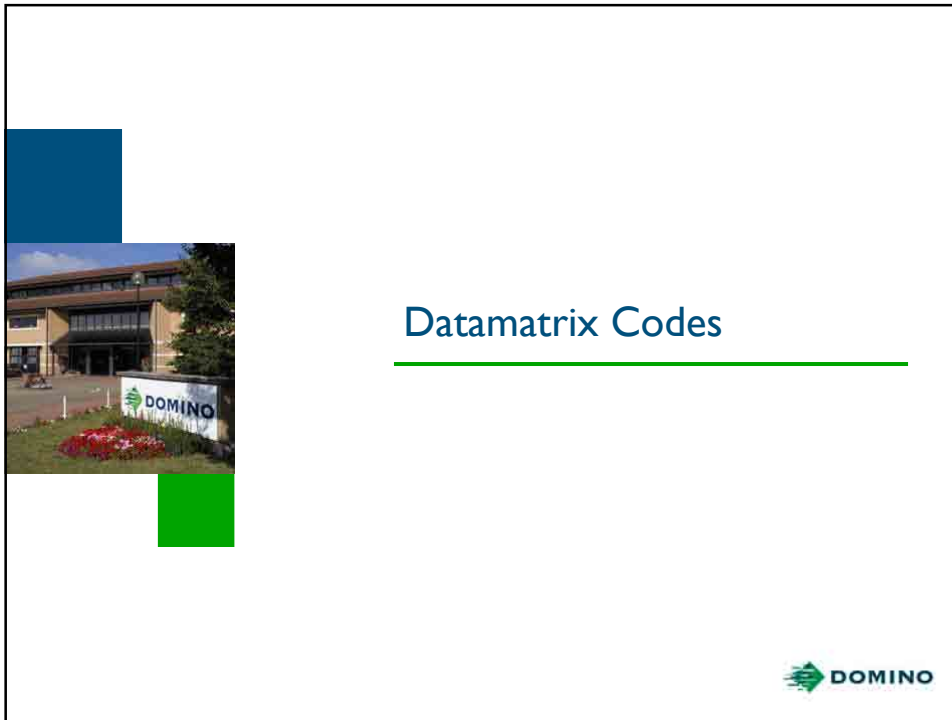
- Is it moving?
  - If not you need to use a static technology
  - Laser, Thermal Transfer, or add a traversing system
- How fast?
  - Normally this rules out some technologies
  - Is it accelerating?
- How big is the printed code?
  - A function of the data contained
- How stable is the handling?
  - High resolution, means smaller dots so it needs high quality handling
  - You may need to change location to get good results



## And afterwards?

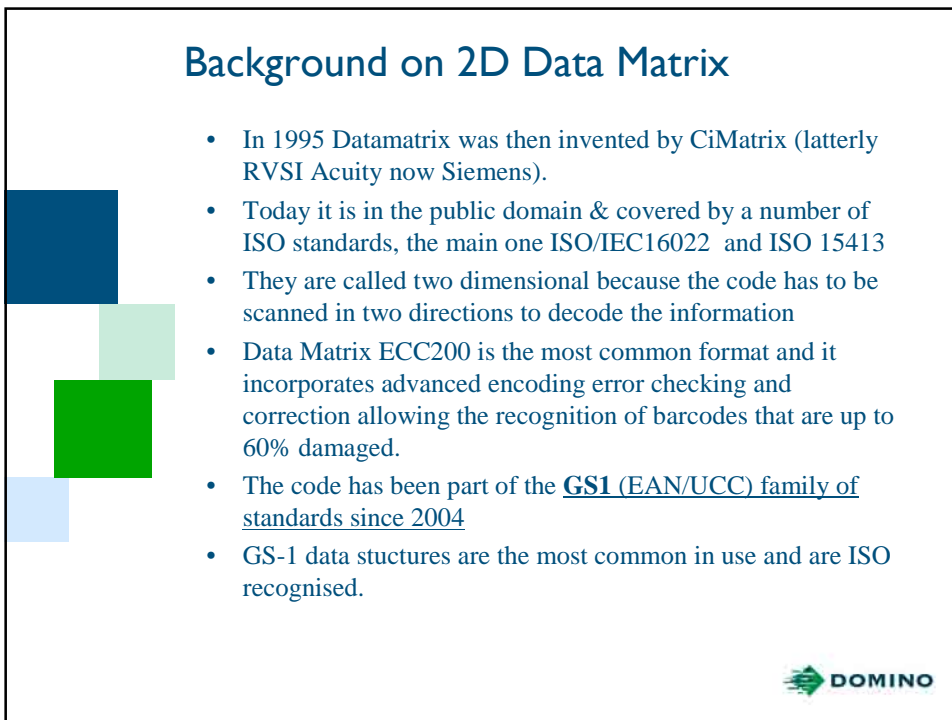
- Most inks & Ribbons can be removed with something
  - Unless UV cured
- Sterilisation can be very good at this
  - Cartons and labels need care
  - Syringes and Vials need careful thought





## Datamatrix Codes

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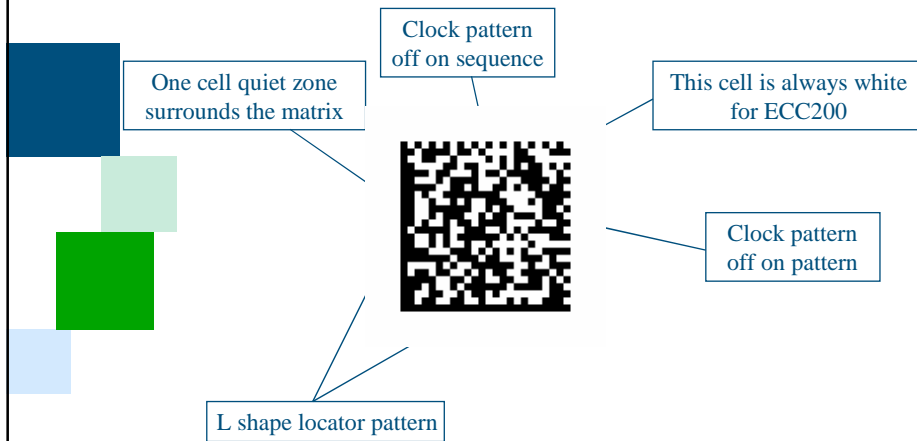


## Background on 2D Data Matrix

- In 1995 Datamatrix was then invented by CiMatrix (latterly RVSI Acuity now Siemens).
- Today it is in the public domain & covered by a number of ISO standards, the main one ISO/IEC16022 and ISO 15413
- They are called two dimensional because the code has to be scanned in two directions to decode the information
- Data Matrix ECC200 is the most common format and it incorporates advanced encoding error checking and correction allowing the recognition of barcodes that are up to 60% damaged.
- The code has been part of the GS1 (EAN/UCC) family of standards since 2004
- GS-1 data structures are the most common in use and are ISO recognised.



## Example Data Matrix ECC200



Cell size is important- 0.015 inches/0.33mm seems to give best read rates although smaller is technically acceptable



## Why is Data Matrix popular?



## So what is a good Datamatrix?

- One that reads?
  - Most readers will work on pretty poor Datamatrix
- Verified to a grade?
  - Verifiers are not 100% consistent
- One that looks good?
  - Good appearance does not mean a good code
  - What is good?
- One that is formatted correctly?
- Most will still read...the technology is pretty robust



## Grading Data Matrix

- If you are used to the verification of linear barcodes, some of the grading terminology will be familiar to you:
  - 16022
    - Symbol Decode
    - Cell Size Symbol Contrast
    - Print Growth
    - Unused Error Correction
    - Axial Non-uniformity
  - 15413 adds
    - Modulation
    - Fixed pattern damage
    - Grid non uniformity
    - Unused error correction



## GS-I and Data Structures

- Data Matrix projects are usually built of a coding definition with more than one item of data
  - Editing and management important
- GS-1 and ISO 15424 define the data content for the codes
- GS-1 structures are the same across all symbol types
  - EAN128 (linear)
  - RSS/Databar –Linear or 2D
  - Datamatrix- 2D

FNC1	AI	Data	AI	Data	ETC
------	----	------	----	------	-----



## GS-I basic rules

FNC1	AI	Data	AI	Data	ETC
------	----	------	----	------	-----

- FNC1 means “GS-1 data structure follows”
- Each AI number defines the content and length following it
- GTIN usually first (13 +1 Numeric)
- Variable length fields go at the end otherwise they need an extra GS character
- Mixed formats need more space than just numbers- they are less efficient
- More content means a bigger symbol



## The Pharma Data Matrix Standards

- All are based on GS-1 data structure
- Implementations often going beyond the minimum
  - More data items
  - More lines of print
- IFAH
- EFPIA
- USA Pedigree
- USA RFID backup



## IFAH Code- deadline at end of 2007

- A standard developed by 95% of EU Veterinary companies
  - Pfizer, Merial, Bayer, J&J, Novartis etc
- Has three versions- unit level, pack and shipper
- 16 by 36 or 20/22 square needed for IFAH data
- Supports food directive- improved animal “passports”
- Will be required on all packs in supply chain from the end of this year





## EFPIA

- Based on GS-1 Standards
- Adds serial number to IFAH standard
- Requires bigger Data Matrix code- 16 by 36 or 24 square
- Serialisation element means each code different- more of a systems and processing challenge



## USA Pedigree

- Technical standards unclear as yet
- Looks like it will be similar to EFPIA
- As its serialised, systems element will be significant
- California has passed a bill requiring implementation in 2008
  - Bill before USA senate that would increase this requirement across USA



## USA RFID backup

- Concept is to back up RFID tags encoded with GS-1 SGTIN
  - SGTIN is a special Serialised format
  - Every code different
- Typically needs a 22 square Data Matrix code as a back up
- Same printing challenges, different data format



## What do you NEED?

- Consistently readable Data Matrix codes
  - At full line speed- previously set for human readable only
  - More lines of text too
  - On all your package types
  - With high OEE
  - Quick product changeover



## What have we found



- Most Data Matrix code applications add other extra printed information
- Many customers want to go beyond the minimum industry definition in human readable (CIP and IFAH)
- Data Matrix codes need better mechanical handling & process control than normal
- Serialisation makes all this even more complex as there is little time for data transfer
- Not all technologies suitable



## Suitable Coding Technologies

- Continuous Inkjet (CIJ)
- Piezo Drop on Demand inkjet (DOD)
- Thermal Drop on Demand
- Scribing Laser
- Thermal Transfer Over printer (TTO)
- Print & Apply
  
- There is NO universal solution, all technologies have their place



## Continuous Inkjet

- The standard coding technique- 60% share globally
- We have invested substantially in evaluation of capability in Data Matrix codes
  - Special software and print formats
  - Training of sales & technical staff



## Piezo Drop on Demand (DOD)

- Good quality on right materials- up to 90m/min
  - Solvent ink or UV cure for wide material compatibility
  - Lots of interest in blister printing at the moment
  - Gives square cells like conventional printing
  - Also suitable for cartons
  - Mechanical handling important



## Unique Codes On Blister Pouches



## Thermal Inkjet (TIJ)

- Becoming established in the Pharma world
- Very short throw distance
- Older system designs cannot do serialised codes at speed
- Ink availability, dry time and “de-cap” time, limit applications
  - May require a dryer
- Real running costs dependant on head wear and clogging, not ink cost

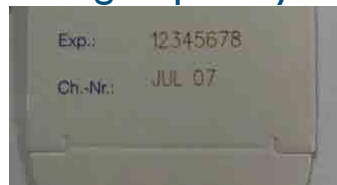


## Scribing Laser

- Static & moving marking
  - Laser reactive lacquers, Labels, Carton board and more
  - Prints text, graphics and Data Matrix codes
- Highly consistent, high quality codes
- Serialisation proven to more than 300/minute
- Fast enough to match Pharma production lines
- In use to back up RFID tags



## Printing Capability - Cartons



## Combination Codes

Data Matrix and Human Readable



RFID, Data Matrix and Human Readable



## Thermal transfer & Thermal transfer Over coder

- For flexible materials, labels and flat cartons
- Use Thermal ribbon print engine
- Thermal Ribbon systems will print excellent quality Datamatrix codes onto labels, Webs or flattened cartons
- Relatively Slow
- Ribbon changes reduce availability
- Tests have shown good solution for suitable materials in some categories
  - Labels
  - Pouches
  - Packaging films

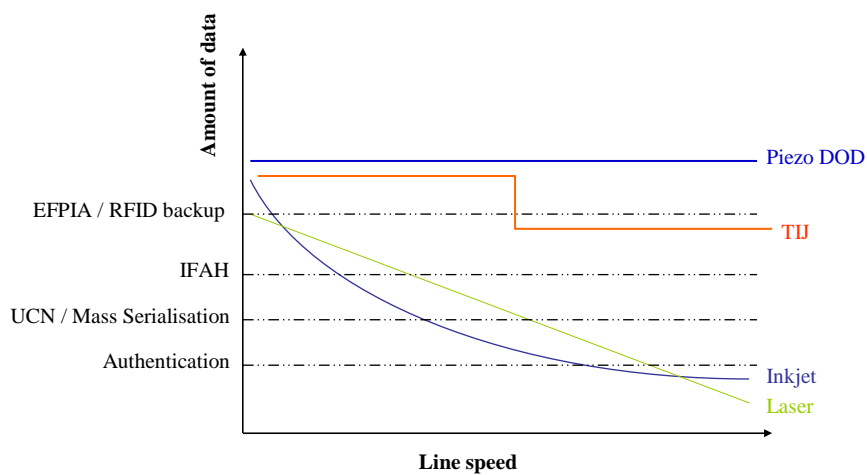


## Print and Apply Labelling

- Use Thermal print engines
- RFID Enabled
- Can print Linear or Data Matrix codes
- Proven in Pharmaceutical Applications
- Can print required data with ease
- But need to be built into the overall data systems



## Data Vs Speed



Human readable information adds to the speed problem





## Conclusions

- Successful Data Matrix coding needs a system approach
  - Careful specification
  - Right printing technology for application
  - Good mechanical handling
  - Good verification
  - Good vision systems
- There is NO universal technology, different packages work best with differing technologies
- System only as good as the worst part



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Αγ. Αθανασίου 17 Τ.Θ. 76  
19002 Παιανία  
marketing@theodorou.gr

Τηλ: 210 6690900  
Fax: 210 6640200  
www.theodorou.gr