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# Inkjet Explainer Series

## Understanding Printhead Requirements for Single Pass Applications

November 9, 2021

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# Get the most from your time with us!

- **SEND US YOUR QUESTIONS DURING THE WEBINAR**
- Question control is in the lower left corner
- We may answer during the presentation
- There is a Q&A at the end
- **Video and audio archive will be uploaded later today along with PDF of slides**

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# Our Explainers

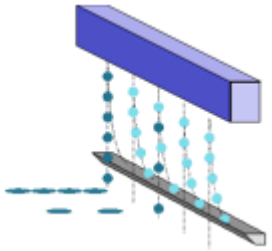
Mary Schilling, Inkjet Insight

Mark Bale, DoDxAct

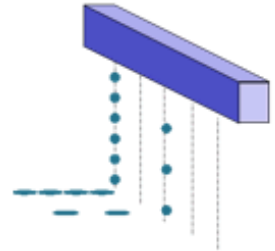
# Overview

1. Printheads- Overview
2. Print Head Resolution– How They Compare
3. Print head – Addressability
4. Print head –Drop Sizes and Speed
5. DPI and Drop Size Market Requirements
6. Case Study in Labels
7. Increasing Speed
8. Stitching

# Print Heads –Overview



**Inkjet Printing**



- Continuous (CIJ)
  - Binary Deflection
  - Multiple Deflections
- Drop-on-Demand (DOD)
  - Thermal
    - Roof-Shooter
    - Side Shooter
  - Piezo
    - Bend Mode
      - Push Mode
    - Squeeze tube
      - Shear Mode

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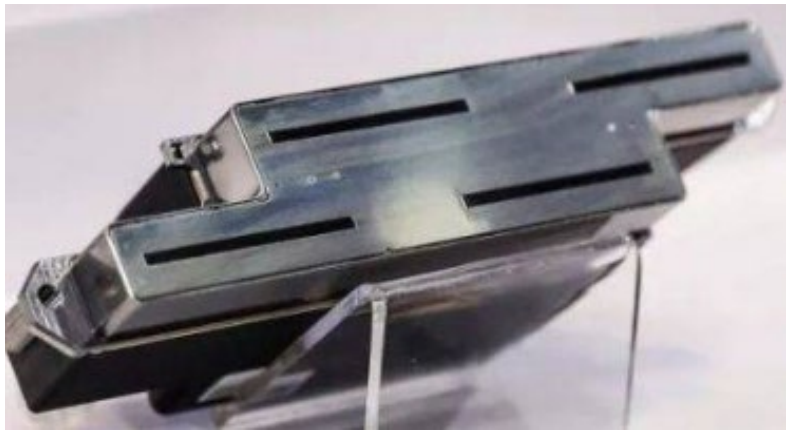
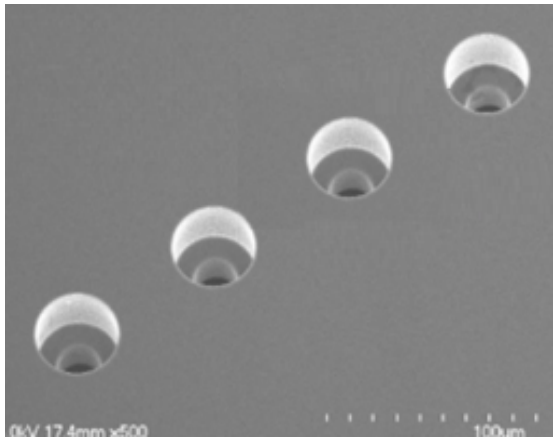
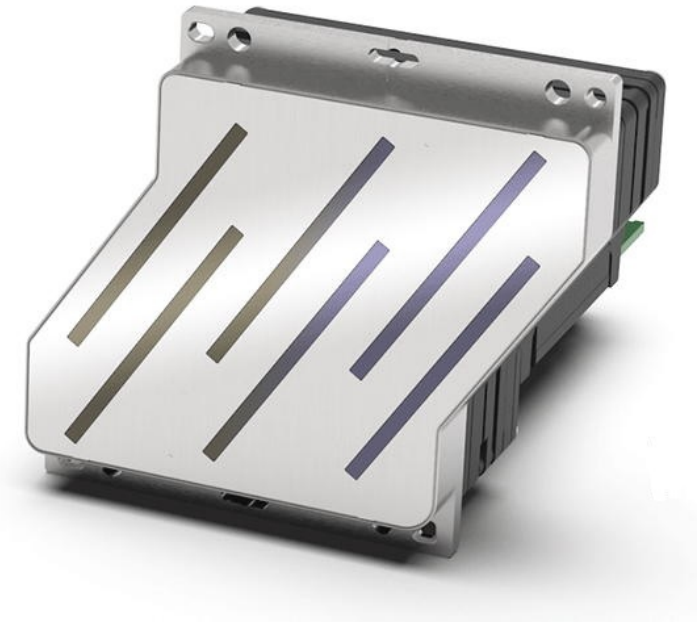
# Print Heads –Market Overview

| HEAD TYPE | MARKET | INK REQUIREMENT |
|---|---|---|
| CIJ,TIJ,PIJ, Valve | Coding and Marking | Adhesion, drying |
| TIJ,PIJ | Wide Format Graphics | Adhesion, weathering |
| CIJ,TIJ,PIJ | Transaction / Promotional Print | Colour, cost |
| CIJ,TIJ,PIJ | Newspaper | Cost, dry speed, colour |
| PIJ, Valve | Ceramic tiles | Colour / function, cost |
| PIJ, TIJ, CIJ | Electronics | Function |
| TIJ, PIJ | Label Printing | Cost, colour, resistance |
| TIJ, PIJ | Packaging | Cost, function, colour |
| TIJ, PIJ | 3D Printing | Function, cost |
| TIJ, PIJ | Decor | Colour fade, cost |
| CIJ, Valve, TIJ, PIJ | Textiles | Colour, fastness, feel |

# Printhead Example – 600/1200 DPI Piezo







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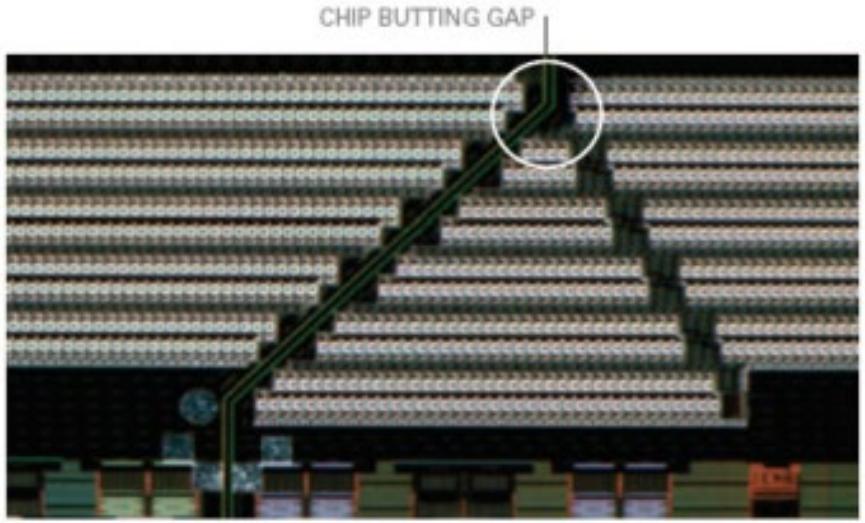
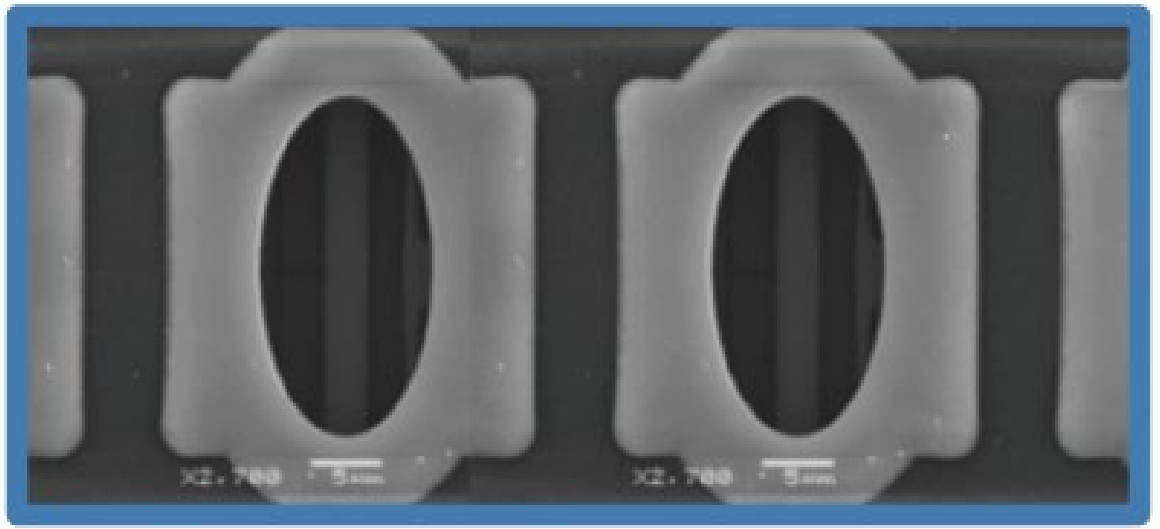
# Printhead Example – 1600 DPI Thermal



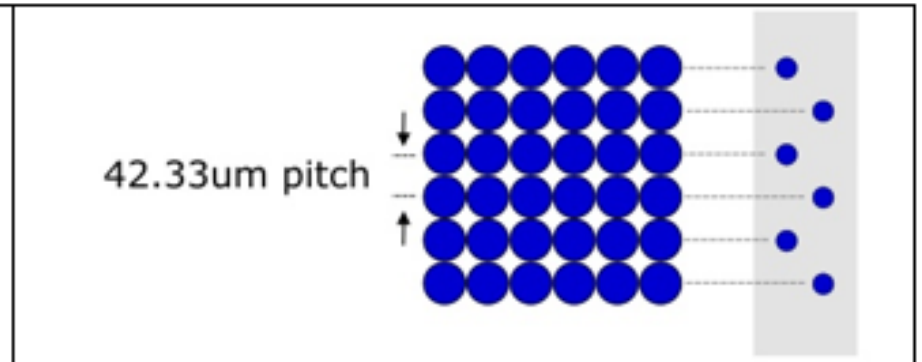
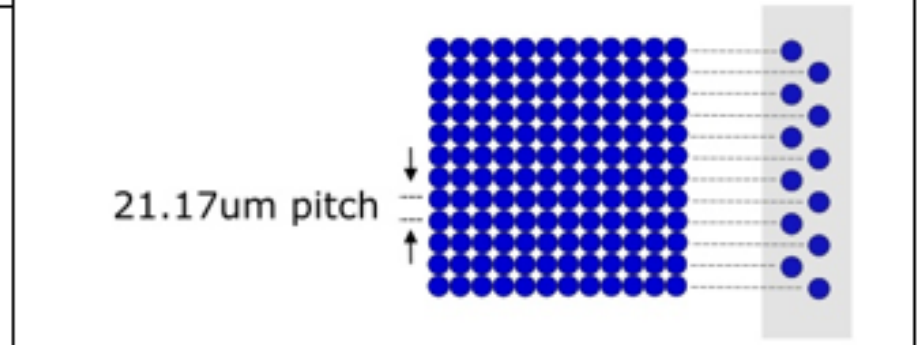
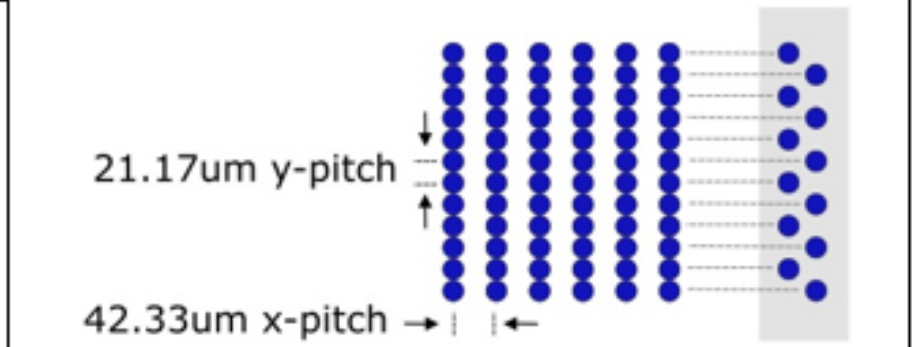
Source: https://www.memjet.com/wp-content/uploads/2019/12/VersaPass_WhitePaper-1.pdf

# Print Process Basics – “Addressability”

Coverage is calculated as:

pixels/m2 multiplied by droplet volume in pL, v:

Coverage (ml/m2) = v*(1x10-9)*(x-DPI)*(y-DPI)*(1000/25.4)^2

| | |
|---|---|
| 600x600<br>(e.g. Ricoh Gen5 / KM1800i) |  |
| 1200x1200<br>(e.g. Samba G3L, Kyocera 1200EX) |  |
| 1200x600<br>(e.g. Samba 5pL) |  |

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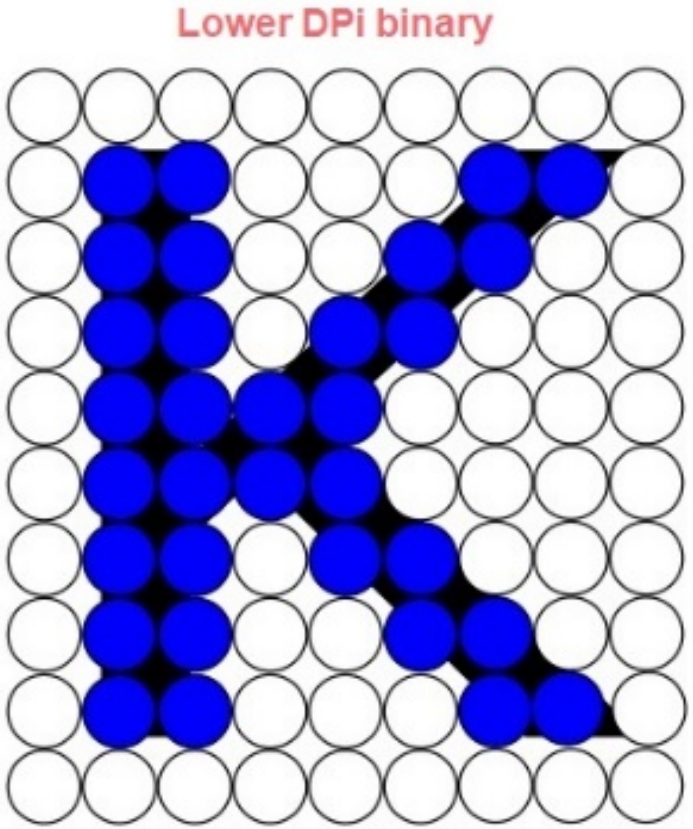
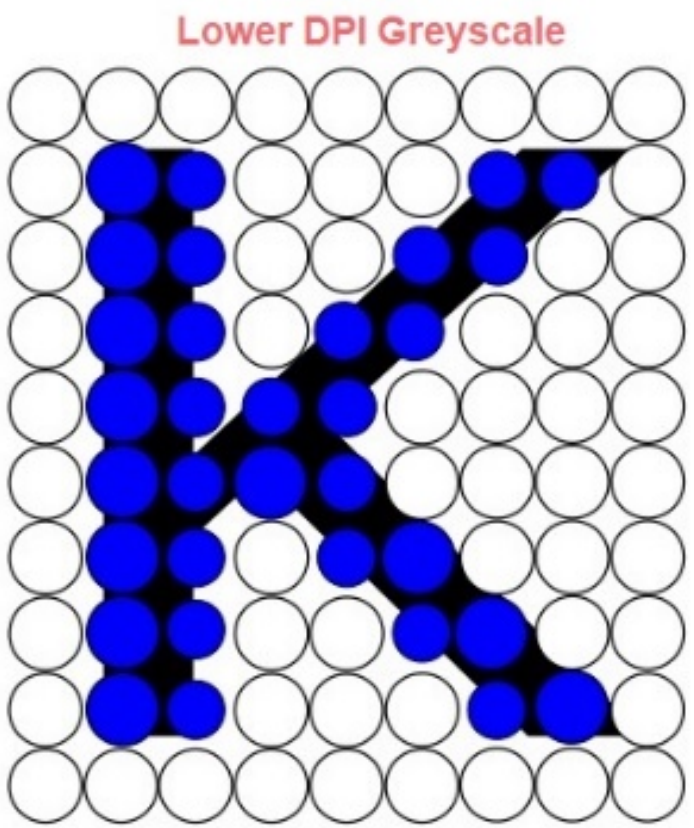
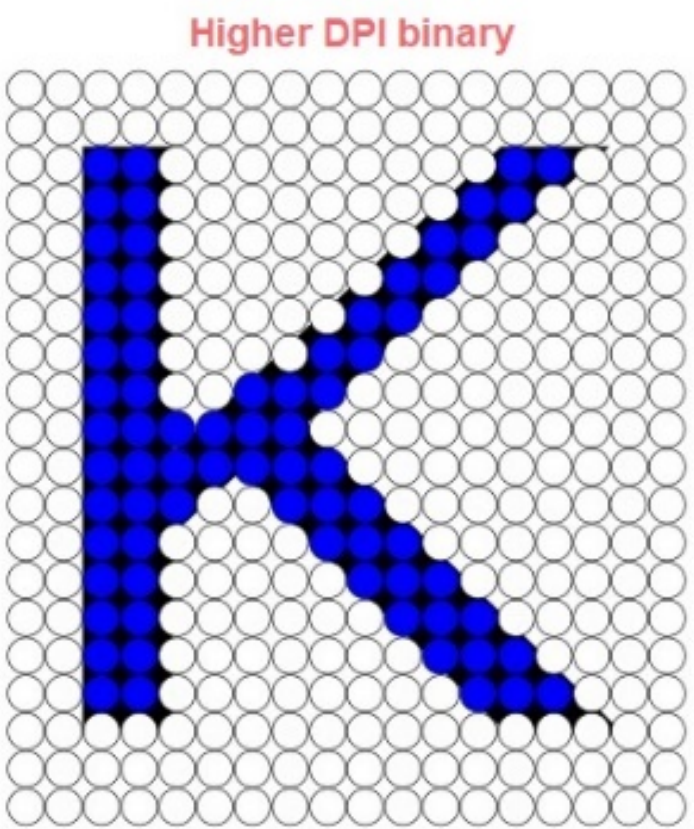
# Addressability & Drop Sizes (Grey Levels)




from: https://imagexpert.com/what-is-grayscale-printing/

reference: https://inkjetinsight.com/knowledge-base/apparent-resolution-even-mean/

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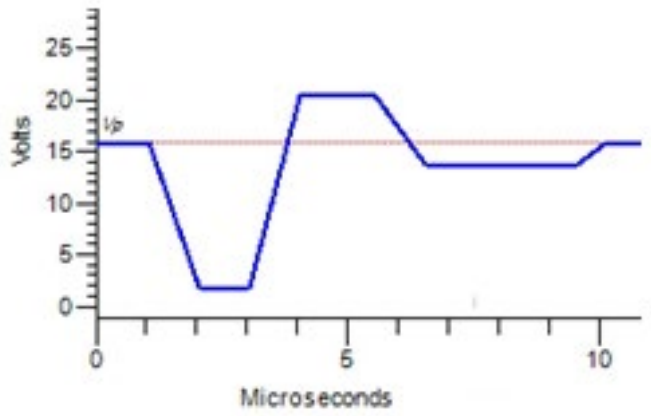
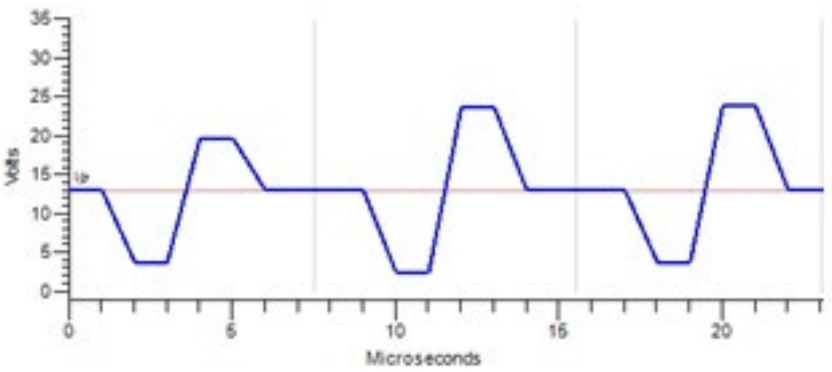
# Drop Sizes (Grey Levels) &  Max Frequency

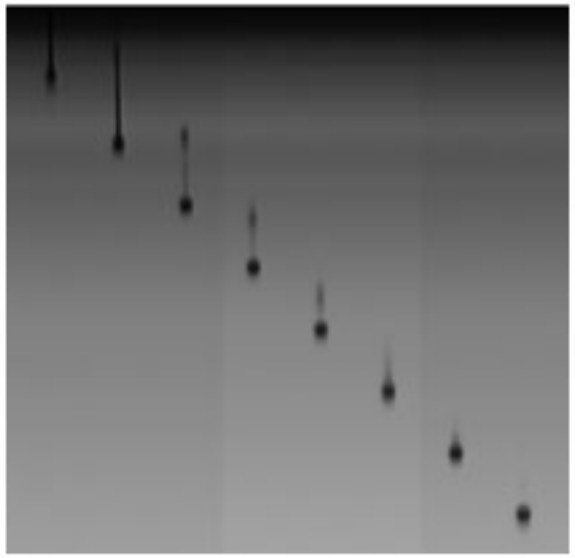
Example: a 11us single pulse drop of 3pL means a potential maximum frequency of 90kHz (>110m/min@1200DPI) at 6gsm.

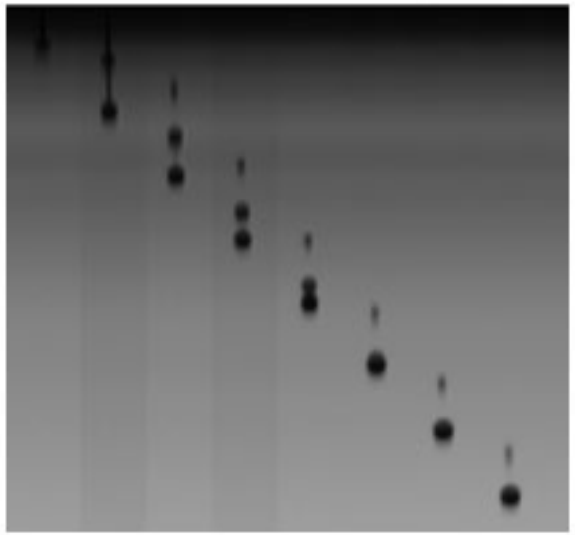
The possible speed achievable reduces to ~50-60m/min for a larger 8pL drop from three pulses but the coverage potential is much higher.

The speed can be increased again by reducing the DPI to 600 and achieving the same coverage as before.





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# Blink and you'll miss it!

***Fun Fact: Inkjet droplets hit the substrate in approximately one thousandth of the blink of an eye ****

* https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4043155/

# Print Heads & Process – DPI vs. DPD

| | | MARKET vs. DPI/DPD | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Min Drop | DPI | | | DPD | | |
| | | Size 6 or < | < 300 | > 600 | > 1200 | 1 | 2 | > 4 |
| Market | Paper | X | | X | X | X | X | X |
| | Textiles | | | X | | X | | |
| | Décor | | X | | | X | | |
| | Edibles | | X | | | X | | |
| | Electronics | | X | | | X | | |
| | Ceramics | | X | | | X | X | |
| | Coding and Marking | X | X | | | X | | |
| | Glass | X | X | X | X | X | X | X |
| | Wide format Graphics | X | X | X | X | X | X | |
| | Manufacturing | X | X | | | X | X | |
| | Bottles/Shapes/Cans | X | X | | | X | X | |
| | 3D Printing | | X | | | X | | |
| | Labels | X | X | X | X | X | X | X |
| | Corrugated- Direct Print | X | | X | X | X | X | X |
| | Corrugated- Preprint | X | | X | X | X | X | X |
| | Packaging- Folding Carton | X | | X | X | X | X | X |
| | Packaging- Flexible | X | | X | X | X | X | X |

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# Printhead “Resolution” – Labels Examples

| Head Manufacturer | Addressability (cross x process) | Drop sizes used | m/min | “Apparent” Resolution |
|---|---|---|---|---|
| Xaar XJ1001 | 360x360 | 7 | 25 | 1018 |
| | 720x360 | 3 | 48 | 1018 |
| Kyocera KJ4B | 600x600 | 3 | 50 | 1200 |
| Xaar XJ1002/3 | 360x360 | 8 | 50 | 1018 |
| | 720x1260 | 1 | 40 | 1350 |
| Ricoh | 1200x600 | 1 | 73 | 1200 |
| | | 4 | 73 | 1900 |
| Fujifilm Samba | 1200x1200 | 2 | 50 | 2080 |
| | | 2 | 78 | 2080 |

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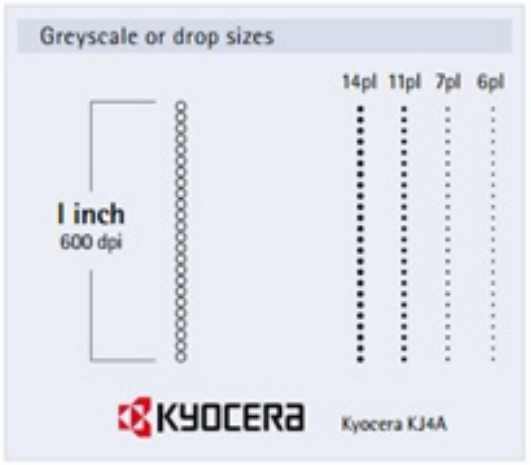
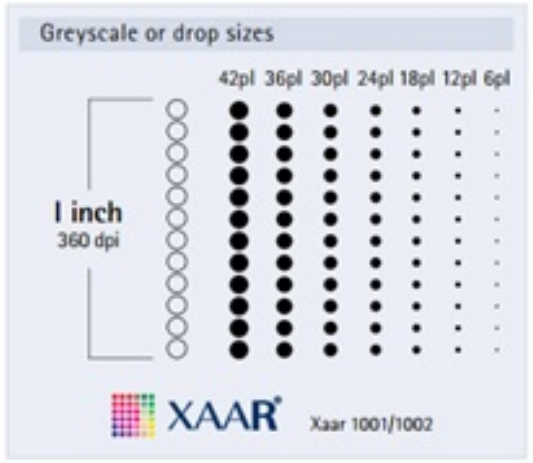
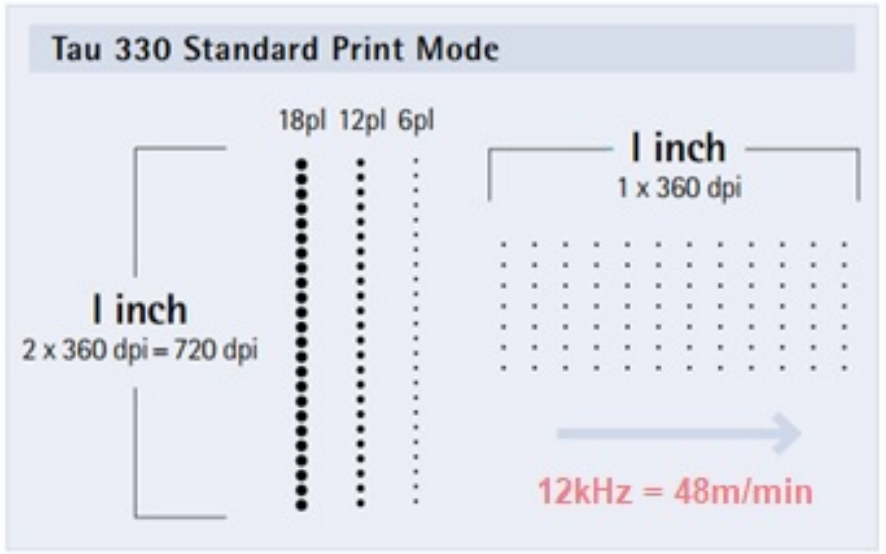
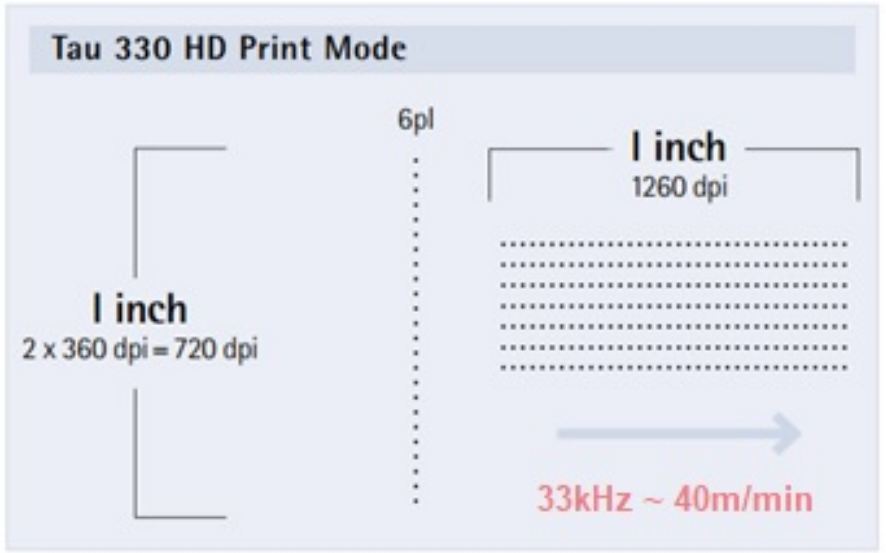
# Printhead “Resolution” – Label Case Study

Reference:
https://inkjetinsight.com/knowledge-base/inkjet-labels-come-of-age/




Source: Durst Tau330 HD Mode White Paper (~ 2014)

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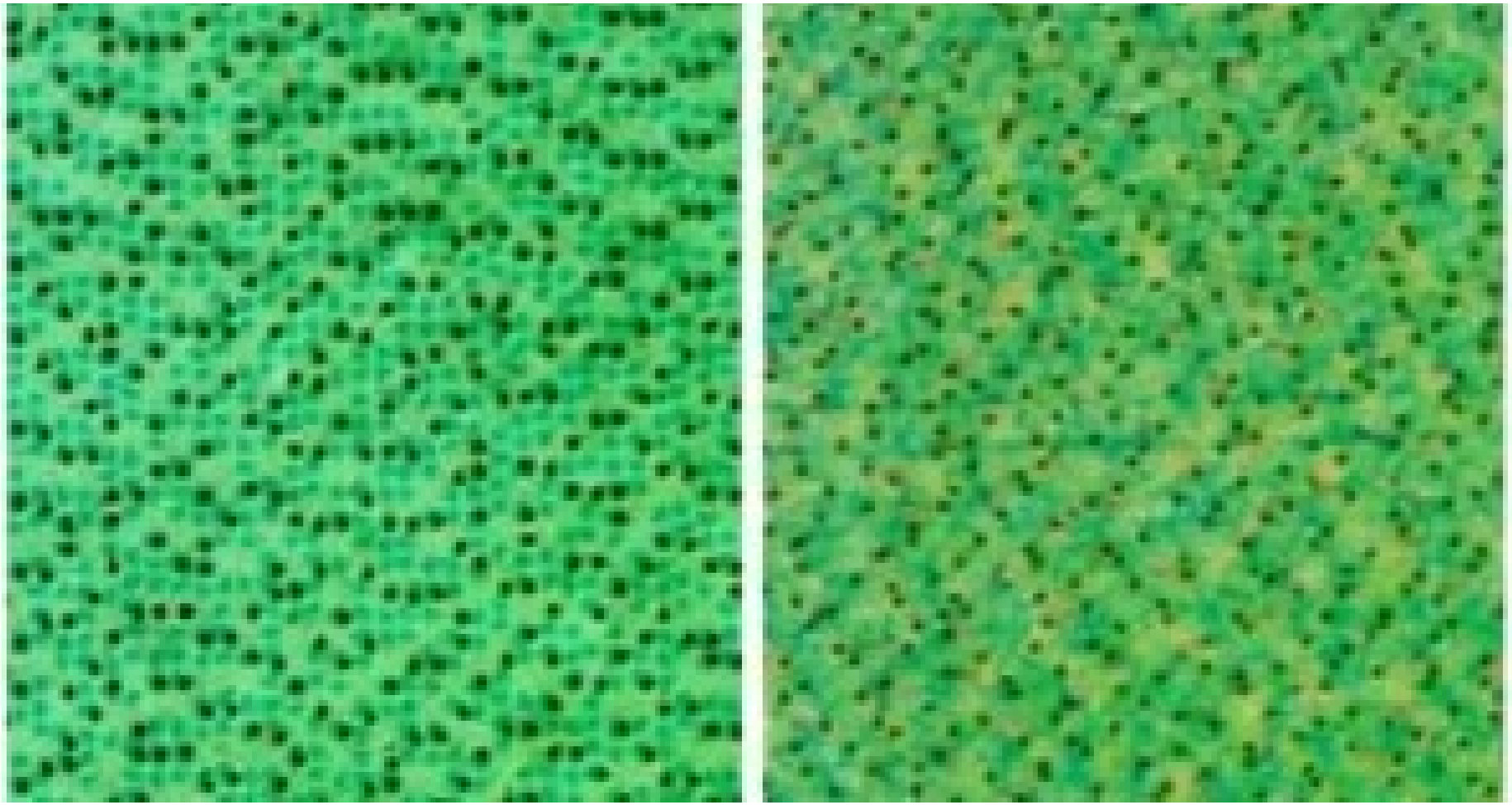
# Real Prints – Label Example



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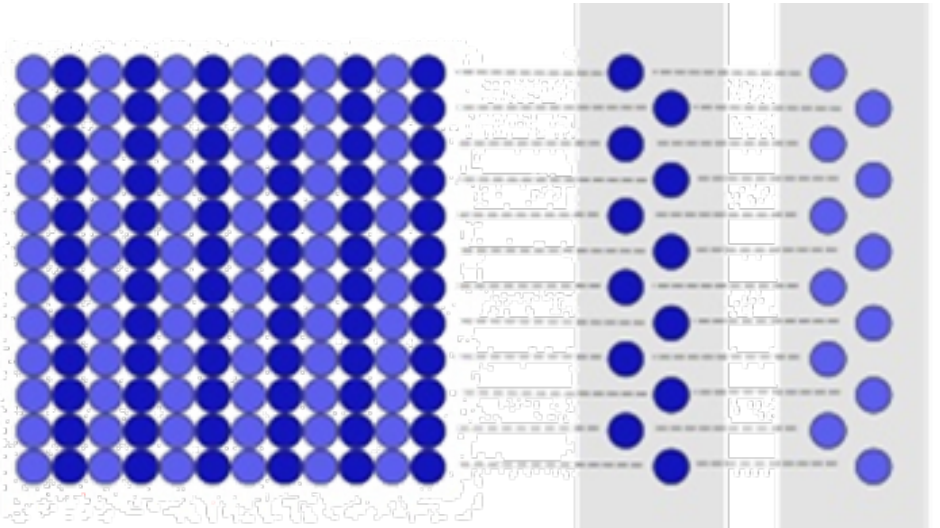
# Printing - Increasing the Speed

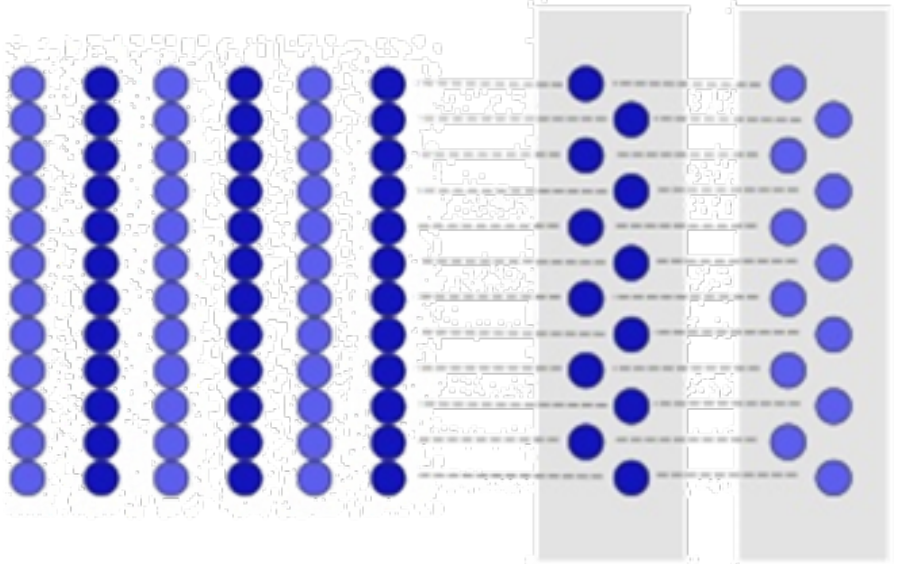
Using an example of F = 30kHz at 600DPI, we have

- Pixels/metre = 1000/25.4*600 = 23,622
- Speed (metres/sec) = 30/23.622 = 1.27
- Speed metres/min = 76.2
- Speed ft/min = 250

X-DPI interlaced 2x1200dpi



X-DPI interlaced & shared between 2x1200dpi



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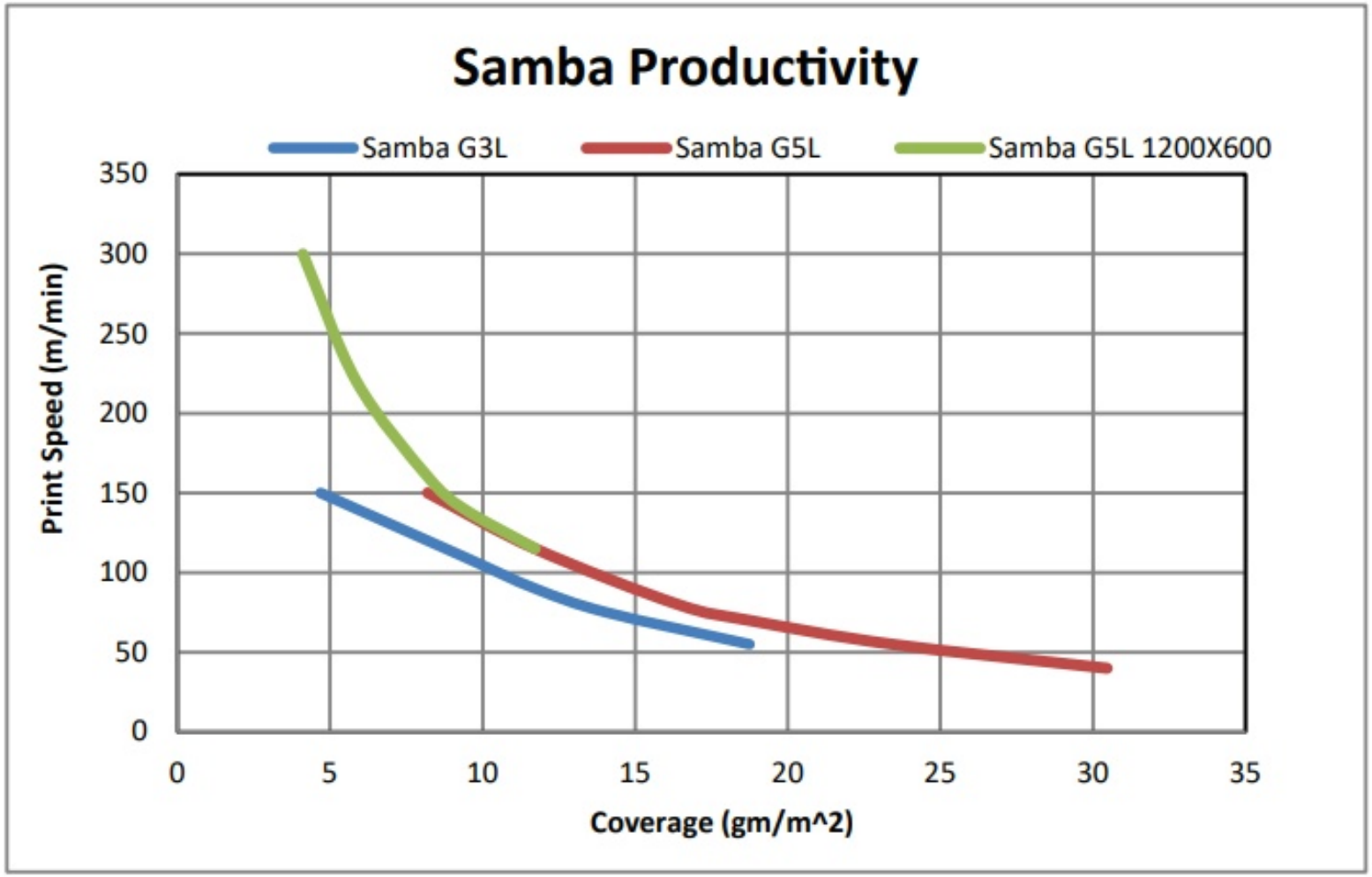
# Print Head - DPI vs. Speed / Addressability

Increasing drop size means better coverage at reduced addressability in print direction

Reference: https://inkjetinsight.com/knowledge-base/inkjet-labels-come-of-age/




Source: Fujifilm

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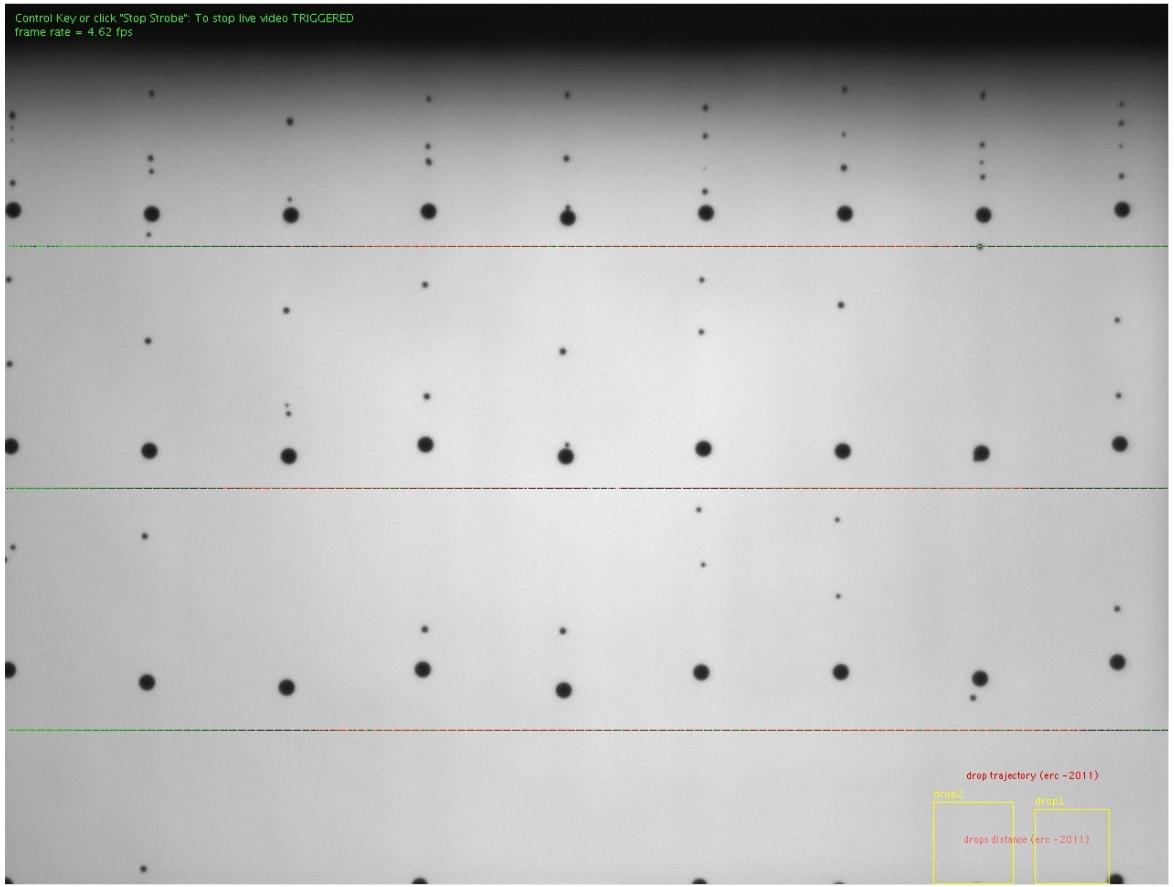
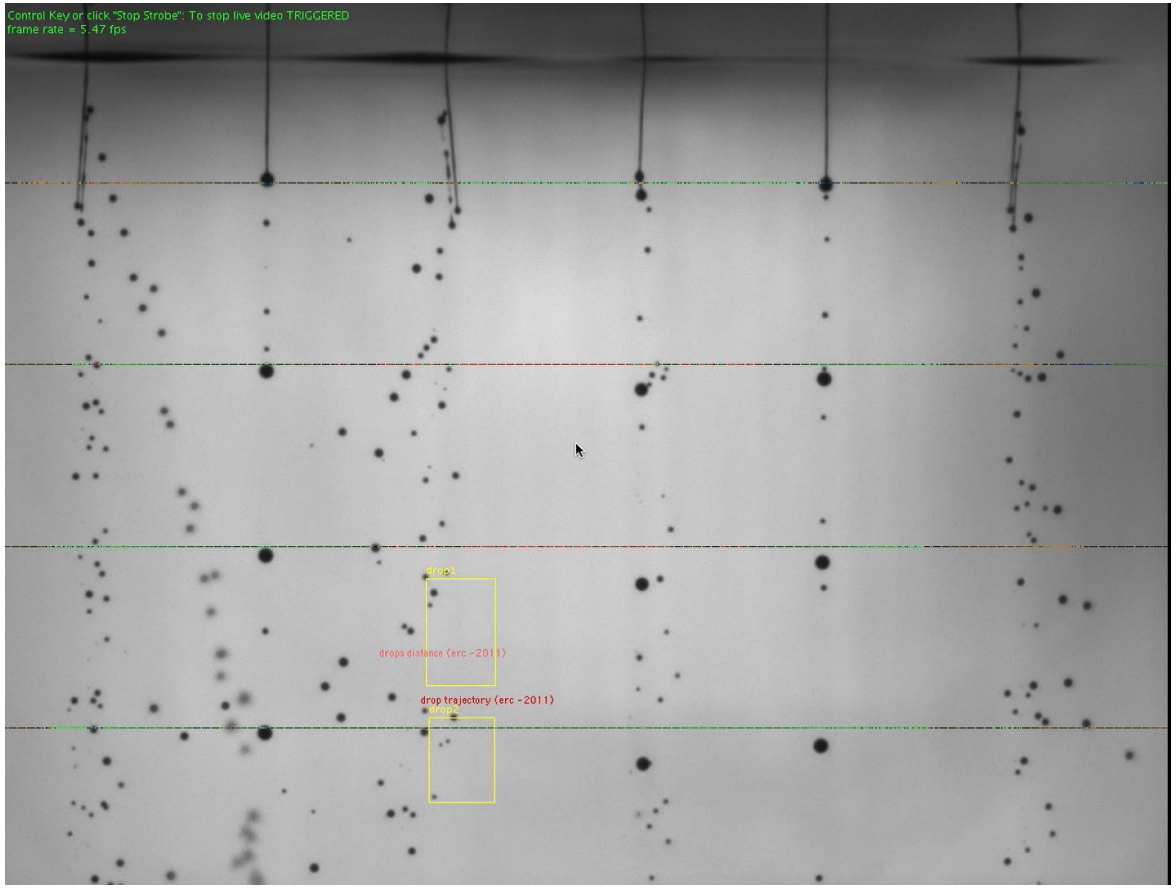
# Importance of Addressability

***Fun Fact: Addressability and drop accuracy is the driving force to achieving print quality***

# Good vs. Bad Jetting

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# High Speed Printing Examples

Thermal:

HP head giving 1200x600 @ 305m/min

CIJ:

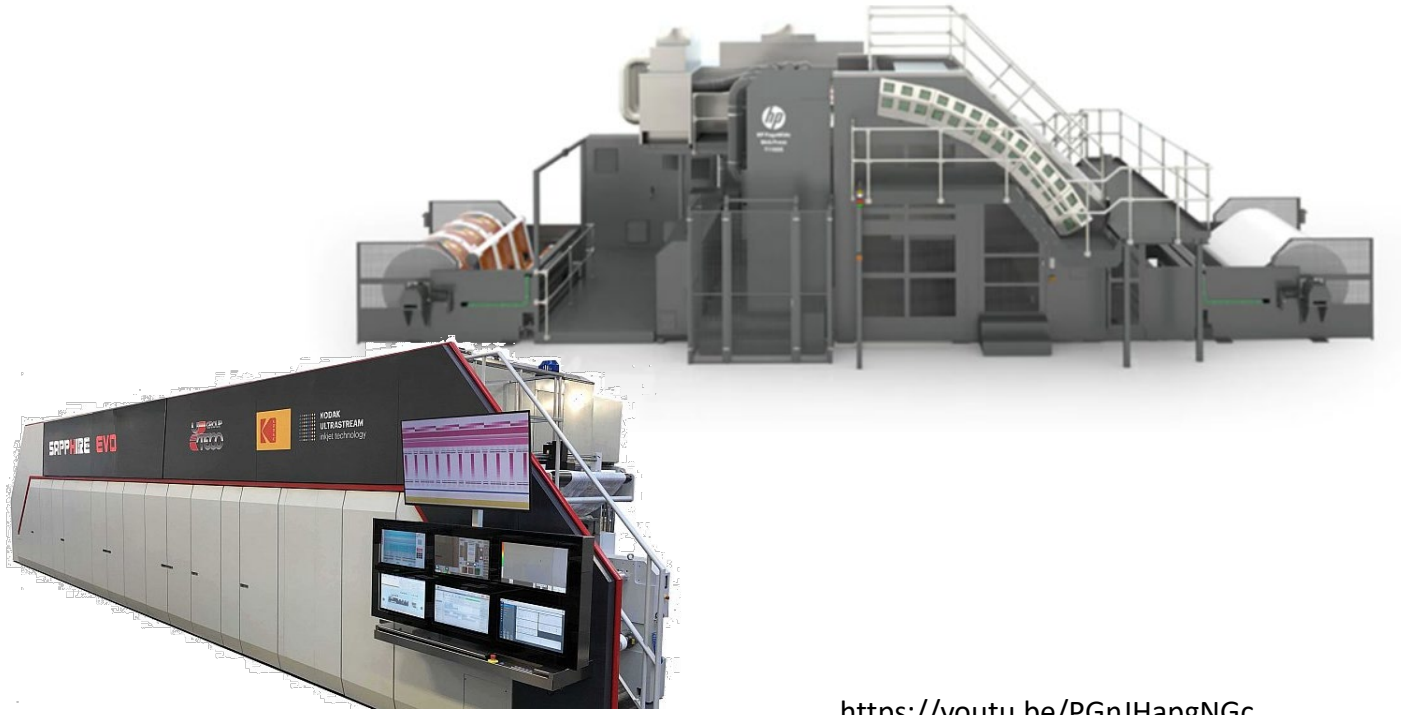
Kodak Ultra Stream

600x1800 for 200m/min

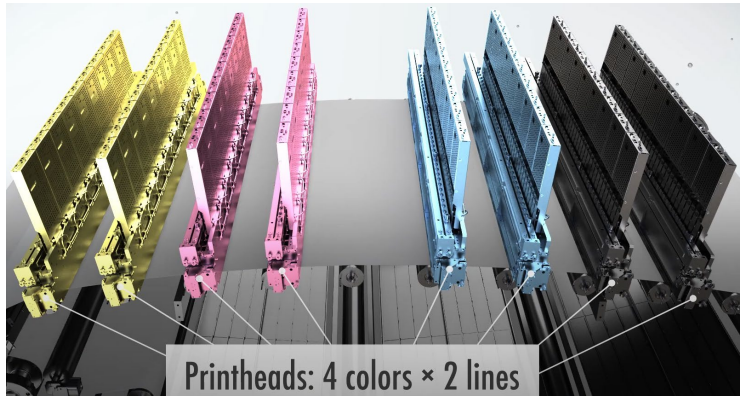
Piezo:

2 bars of Fuji Samba

1200x600 for 300m/min




https://youtu.be/PGnJHapgNGc

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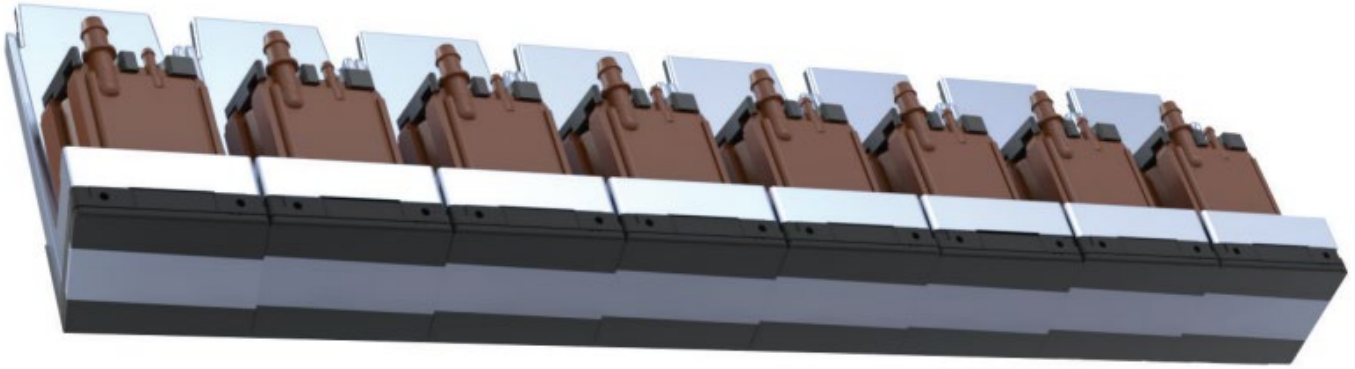
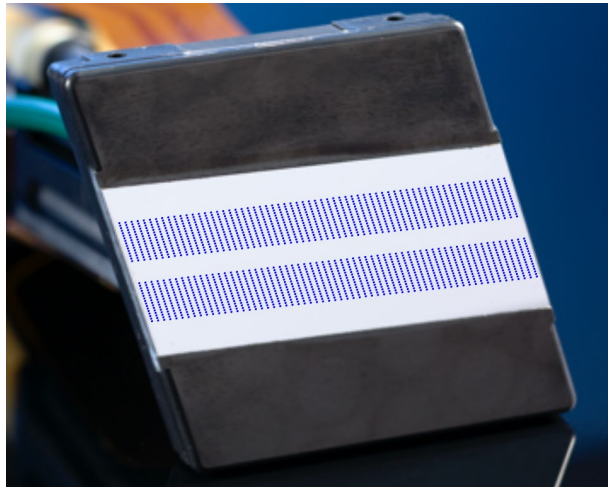
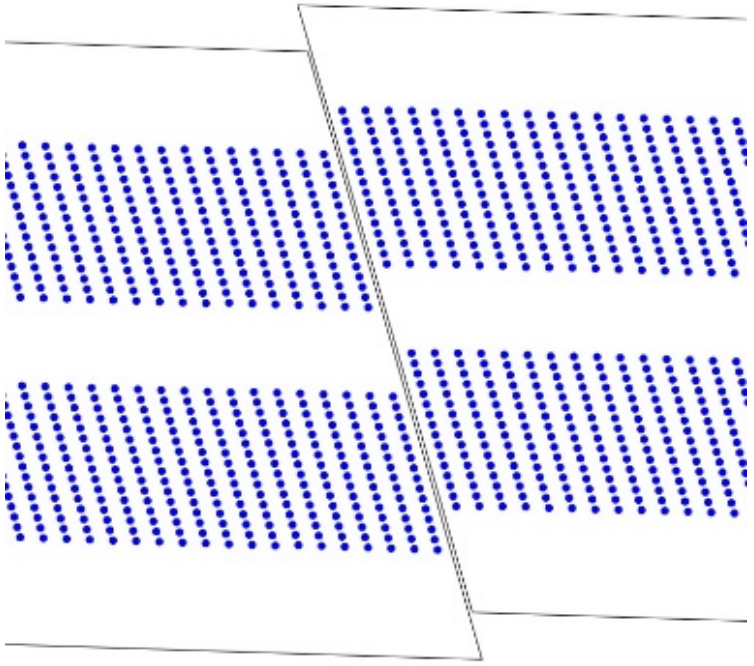
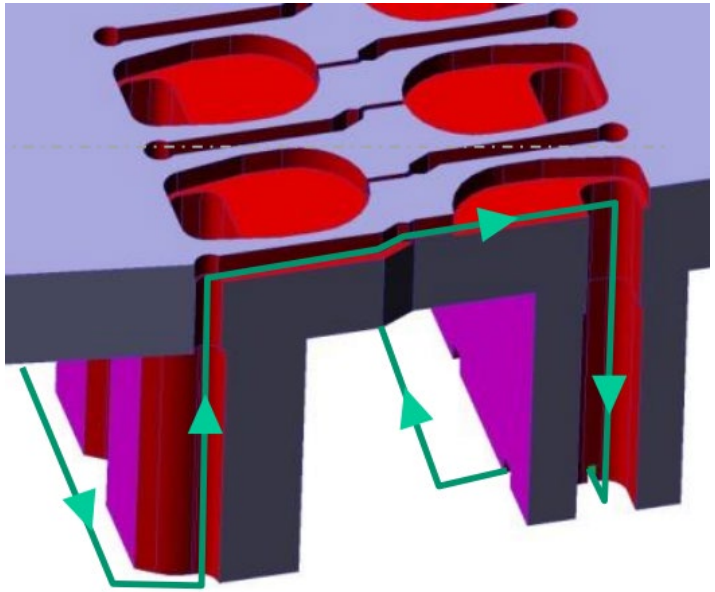
# Printer Design – Art of Stitching









Source: Fujifilm

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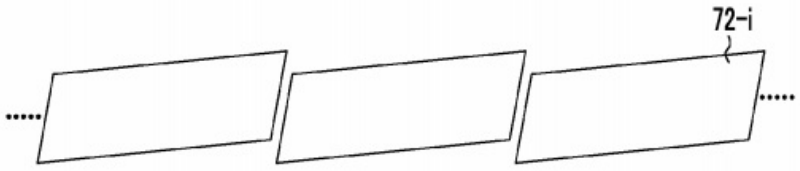
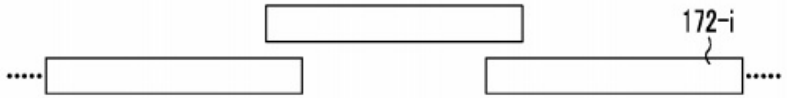
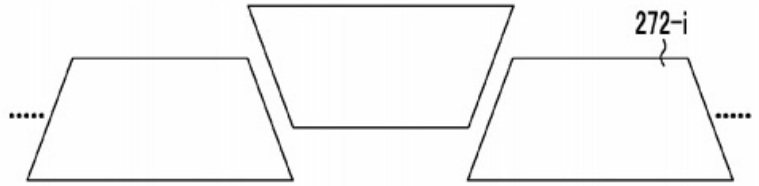
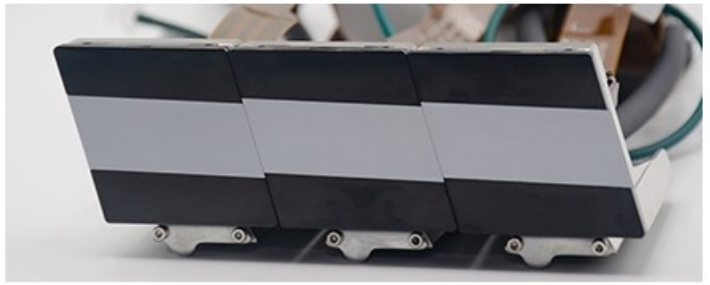
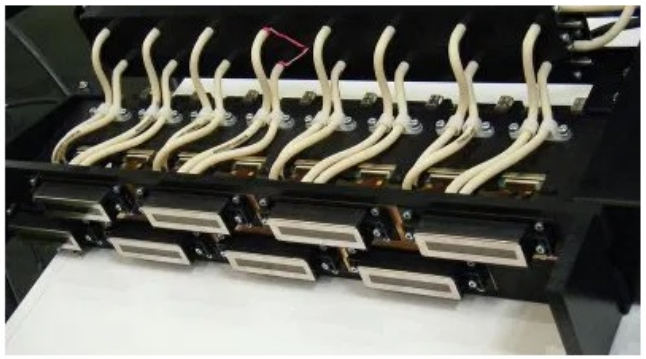
# Printer Design – Art of Stitching

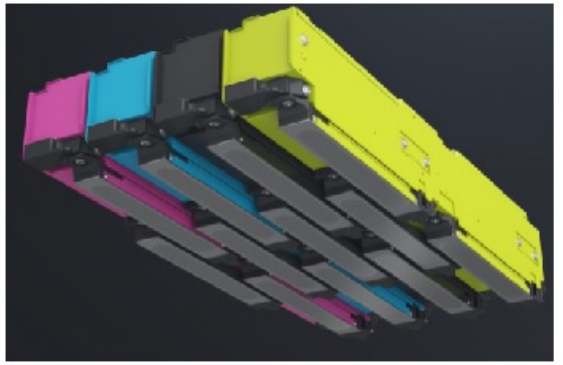






From US8870338B2 (fuji)

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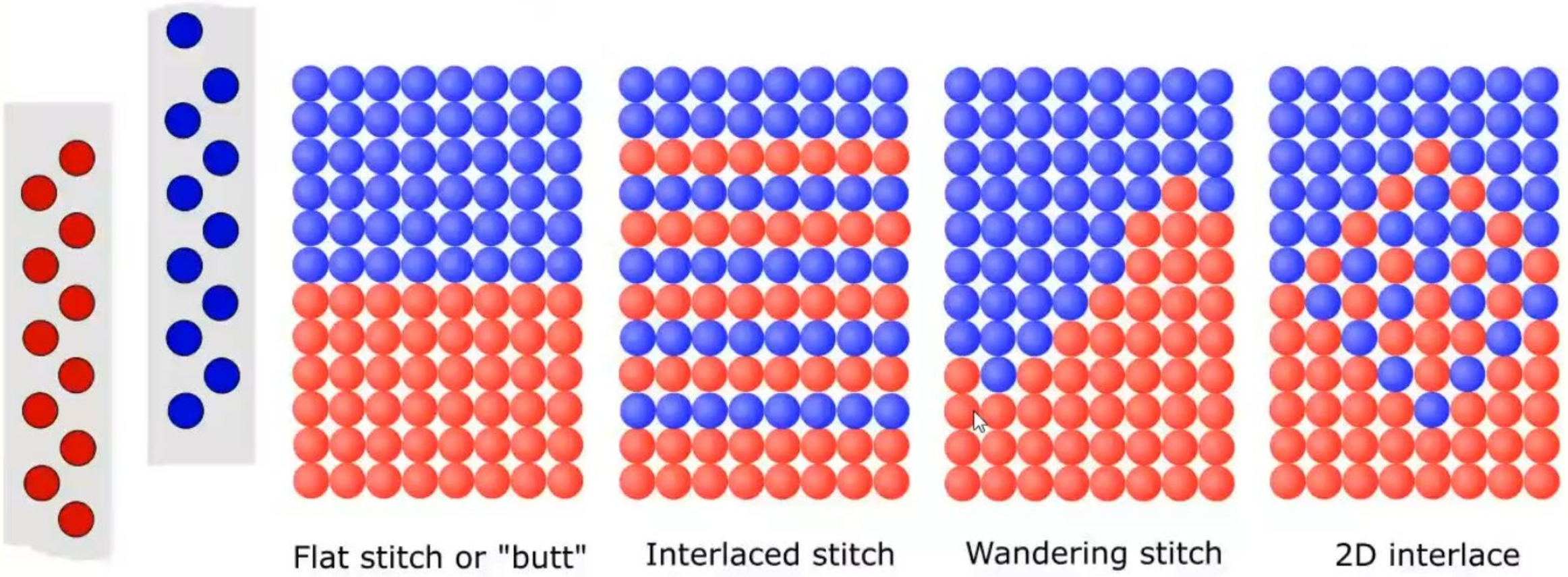
# Printer Design – Art of Pixel Stitching

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# Upcoming Explainers

## Reimagining Transaction Printing for Printers, Designers and their Customers

- Tuesday December 14 @ 1:00 eastern

# Questions?

Inkjet Insight provides valuable tools and resources to help companies objectively **evaluate** the potential of inkjet for their business, **optimize** their operations and **grow** their businesses using production inkjet.

Our Message to Printers, OEMs and the Industry at Large

Evaluate. Optimize. Grow.

**Repeat**

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# Need something explained? Let us know.

**For more information please contact:**

**Mary Schilling**

Mary@inkjetinsight.com

**Elizabeth Gooding**

Elizabeth@inkjetinsight.com

**Thank you for your time and attention.**

We look forward to the opportunity to help you reach new customers through valuable technical and educational content and to grow your business through market analysis and expert media qualification support.