TAGA NextGen

How Color Inkjet Web Printing Can Match Offset Lithography at Production Volumes

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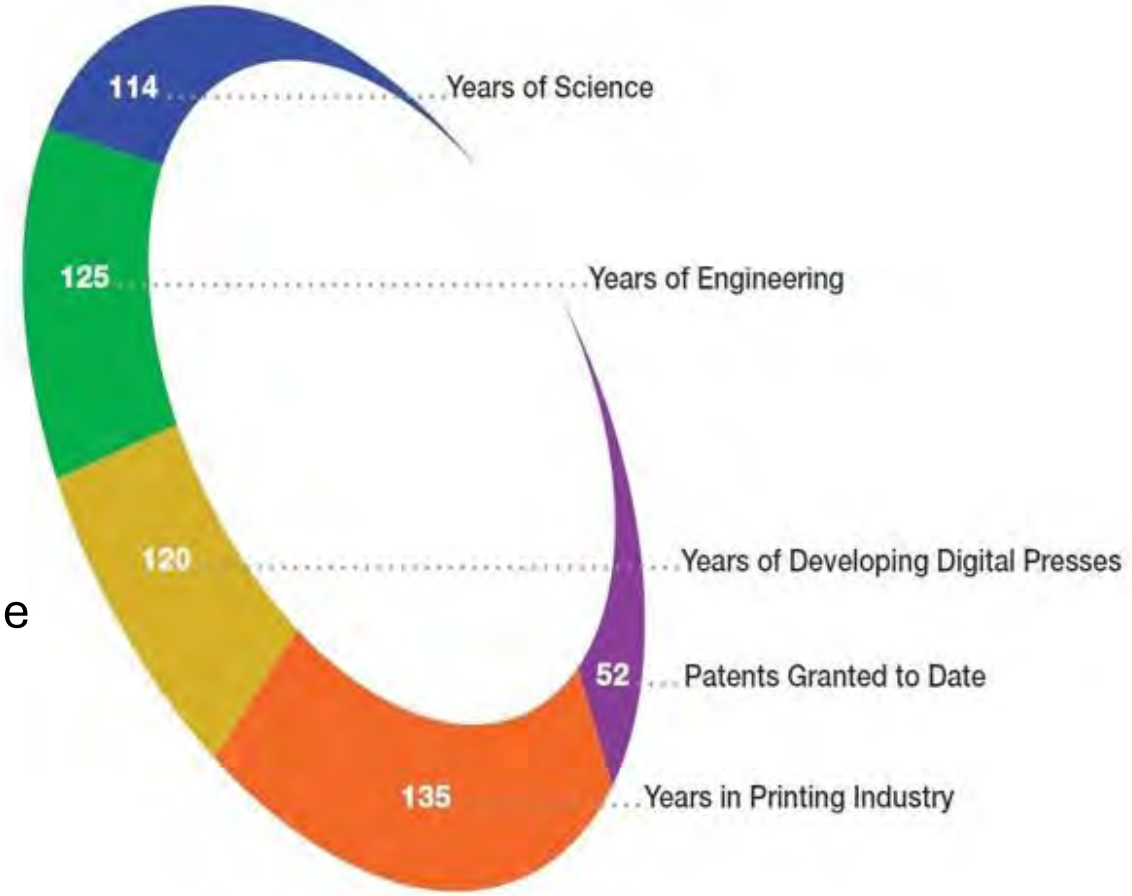
ITL Team Experience

Image Test Labs™

Dr. Peter Crean – Xerox Sr. Fellow
Dr. Peter Dundas – Xerox Chief Color Science
Dr. Eric Zeise – Sr. Kodak Imaging Scientist
Director R&D Henry Freedman

Collective Knowledge Placing Us at the Top

(Team Years of Experience)



Presentation Overview

Evolution of Matching Offset by Electronic Printing Systems

Examples/Samples of Electrophotographic Systems Matching Offset

How we achieved getting Color Inkjet Web Printing to Match Offset Lithography at Production Volumes over 6000 pages+.

Q&A

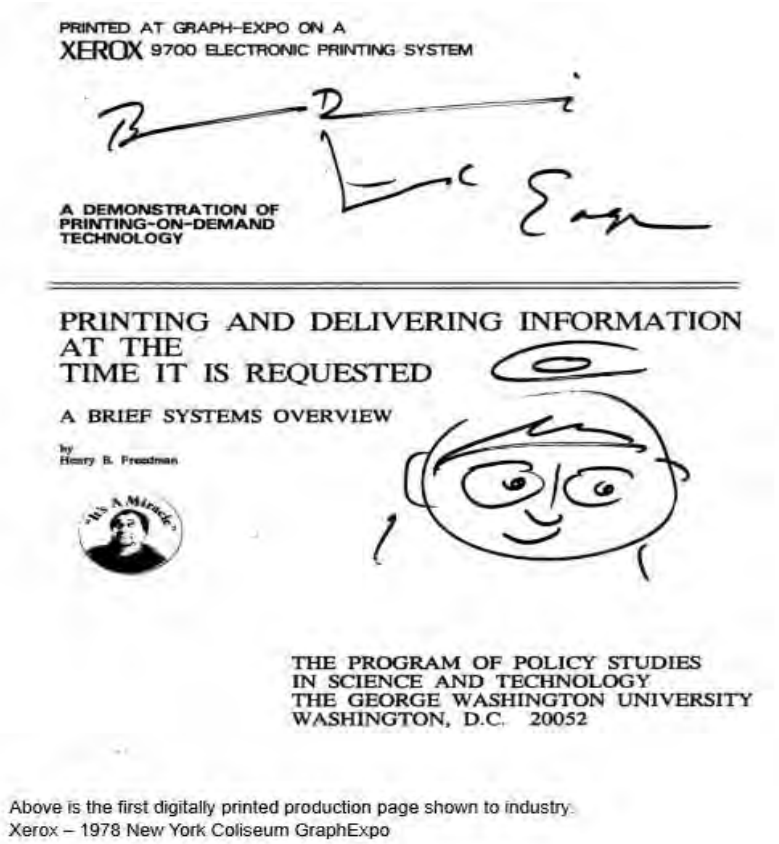
The Worlds First Commercial Digital Press

Xerox 9200/9400 Light/Lens

Xerox 9700 Digital

First Commercially Printed Page on a Digital Press

47 years ago.



PRINTED AT GRAPH-EXPO ON A
XEROX 9700 ELECTRONIC PRINTING SYSTEM

A DEMONSTRATION OF
PRINTING-ON-DEMAND
TECHNOLOGY

PRINTING AND DELIVERING INFORMATION
AT THE
TIME IT IS REQUESTED

A BRIEF SYSTEMS OVERVIEW

by
Henry B. Freedman

THE PROGRAM OF POLICY STUDIES
IN SCIENCE AND TECHNOLOGY
THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, D.C. 20052

Above is the first digitally printed production page shown to industry.
Xerox – 1978 New York Coliseum GraphExpo

Takeaways of the Xerox 9700

1. Xerox 9700 ran at 7,200 monochrome sheets an hr. Same as offset. Thus, first commercial digital press ran at the same speed as an offset duplicator press.

2. The Dmax of the first digital press exceeded offset.

3. A digital font had to be created to drive press. I chose Times Roman and at PARC used SW Mumble and BitBlit to program fonts. (90,000 pixels per square inch. 300x300 matrix How do you get 8 point type ? :)

First Color B2 Type Digital Press
US DoD Digital Battlefield Map Printer

Operation

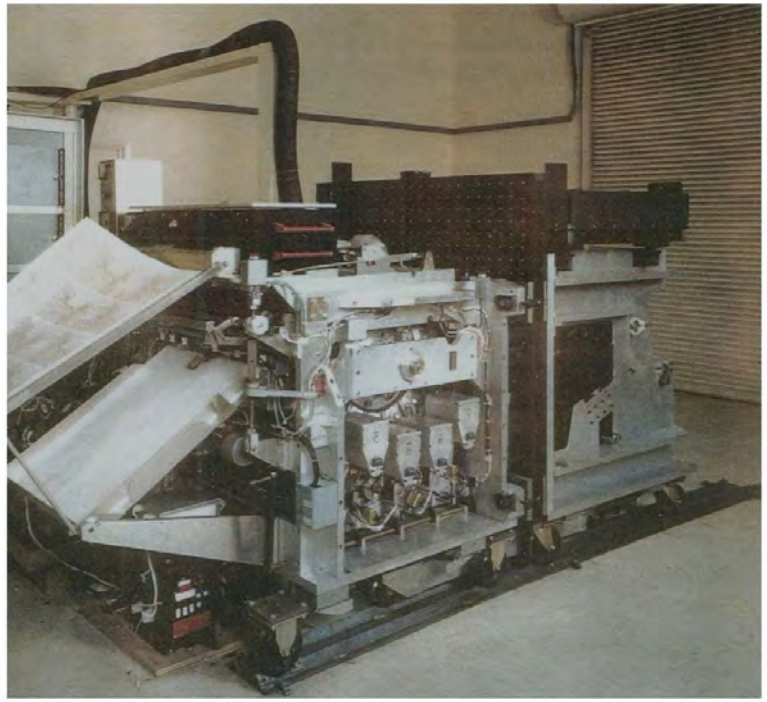
1. Satellite takes picture of enemy in place.

2. Remote sensed image sent to truck with press.

3. Targeting image imposed and printed on geographical map with enemy shown in place and coordinates.

4. Map handed to gunnery officer.

5. Target destroyed repeat. Drive truck forward.



Note this was in development at the same time the 9700 came out.

Also 47 years ago.

Takeaways of Battlefield Map Printer

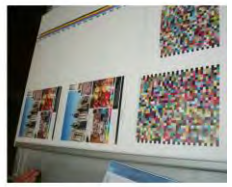
1. Replaced an offset press in the truck. The first digital color press to replace an offset press.

2. Since it used dry toner it works in most theaters of war. Inkjet ink evaporated in desert.

3. The same system was placed on aircraft carriers and other ships since dry toner does not spill like a liquid in rough seas on rocking ship. Too big for a sub.

4. Fastest press delivery in the world. Since the press skid was designed to the size of a Jeep or smaller, can be dropped out of aircraft and air delivered. Nobody could deliver a press to any location in the word faster than we could :)

Examples of Electrophotographic Systems Matching Offset



March 2005

Xerox 8000 2400 Res Fuji VCSL exposure.

Match to Heidelberg Offset 40” 4/c RIT PAL

Ran 9,000 true production run length of match.

“JDF supports the life cycle of print information, and that life cycle begins with the customer’s

ence in this round of testing was the high level of detail involved when verifying the exchanged

year. (www.cip4.org)

Digital Matches Offset Quality

Seeking to demonstrate a quality match between offset and digital printing are (from the left) Henry Freedman, editor of *Technology Watch*; Peter Dundas, principal color scientist, Xerox Corp.; Peter Crean, senior fellow, Xerox Corp.; Bill Garno, director of RIT’s Printing Applications Laboratory; and Franz Sigg, senior research associate in RIT’s School of Print Media.

ROCHESTER, NY—Xerographic printing of color images is matching the quality of offset lithography for the first time, asserts Henry Freedman. The Rochester Institute of Technology (RIT) alumnus and publisher of the *Technology Watch* newsletter has teamed up with RIT’s Printing Applications Laboratory and Xerox Corp. to do a print quality demonstration.

The test image was first printed via offset at RIT, then Xerox produced the identical image on a DocuColor 8000 digital printing system. Samples from each run will appear side by side in a future issue of the newsletter in order to enable readers to judge the process matching for themselves.

“We are at a major crossroads today where digital printing processes can substitute for traditional printing processes closer to production speeds of 80 pages a minute,” Freedman says.

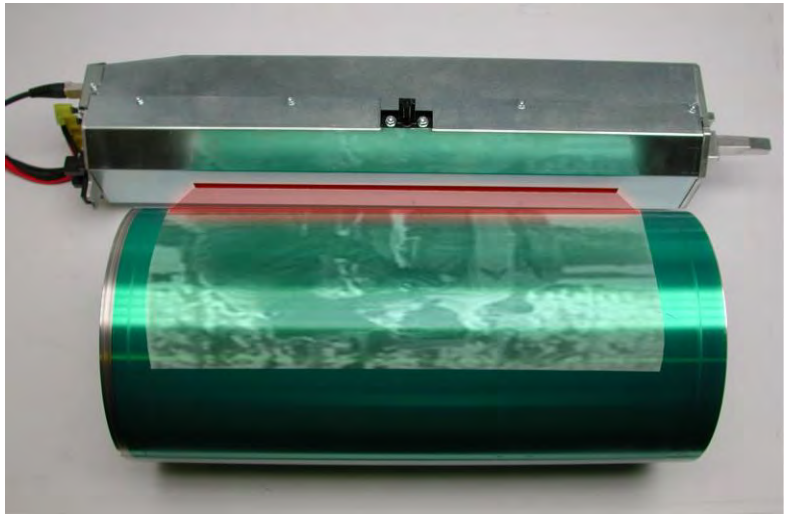
Printing Impressions • www.piworld.com

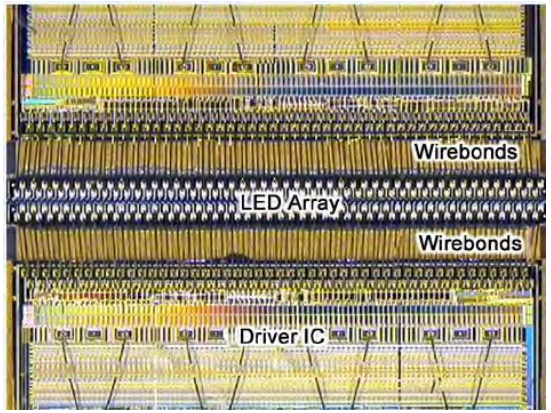
March 2005

Kodak Nexpress

Amazing LED Array Imaging Capacity

14,284,828 addressable levels per sq centimeter !





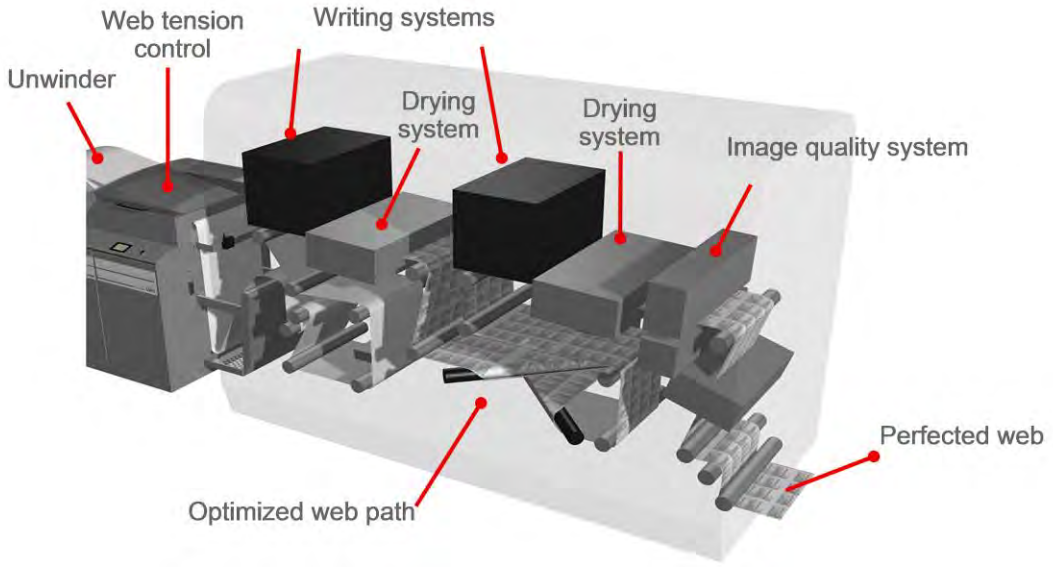
Nexpress Matches Offset

Matching Electrophotographic Color Printing to Offset Lithography Color Measurement Targets Perform Magic – Freedman p33 RIT Test Targets 6 2006

Nexpress Unsurpassed Imaging Capacity Can Print ConTone Photographs beyond Offset Quality

Proceeded to Match Offset to Many More Digital Presses

- Fuji J Press
- Hp Indigo Press line
- KM Press Line
- Xerox Press Line
- Kodak Press Lines Toner & IJ
- OCE
- Canon Press Line
- In development unreleased press simulator tuning.



Parts of an InkJet Press

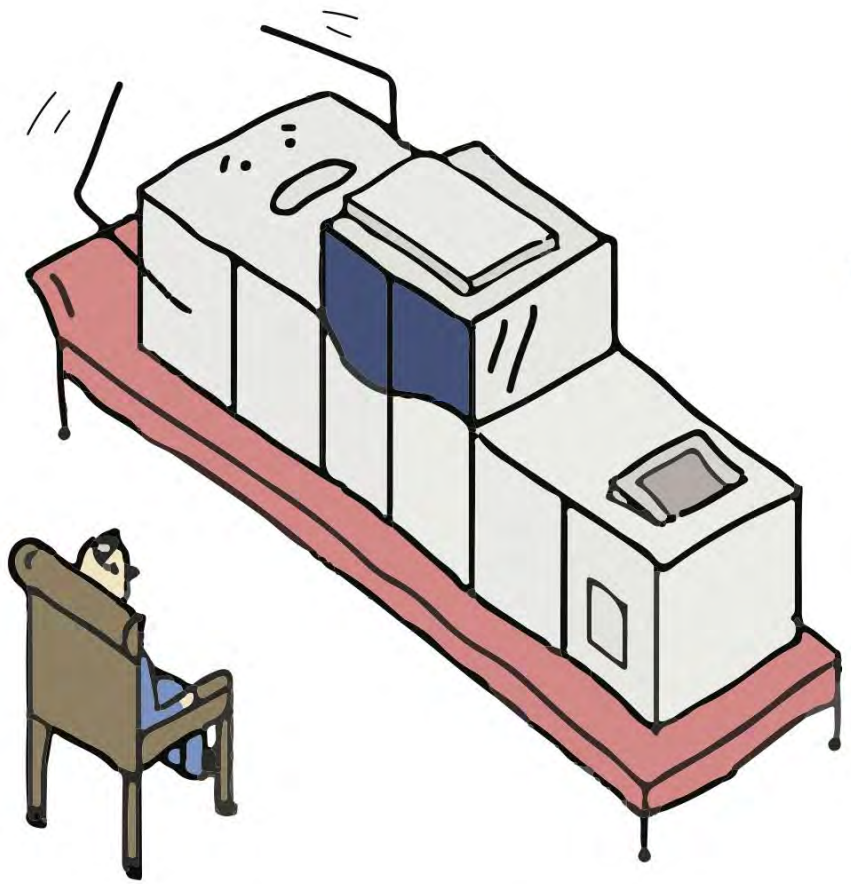


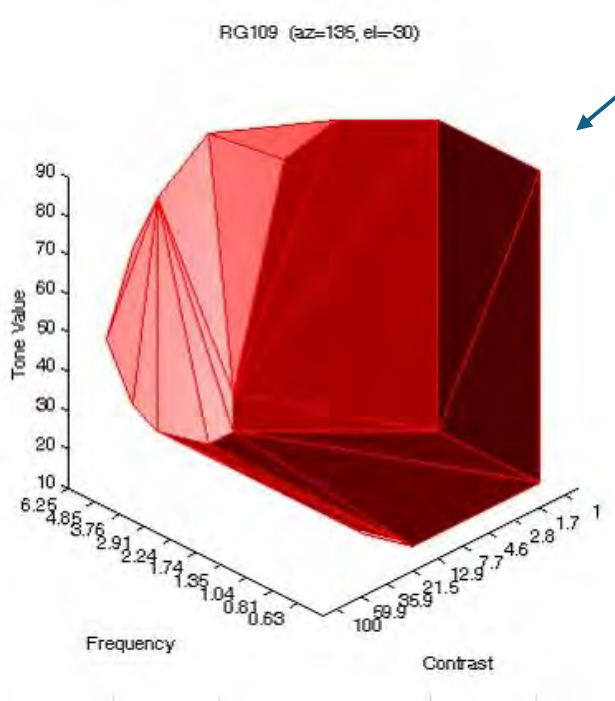
Image Test Labs™

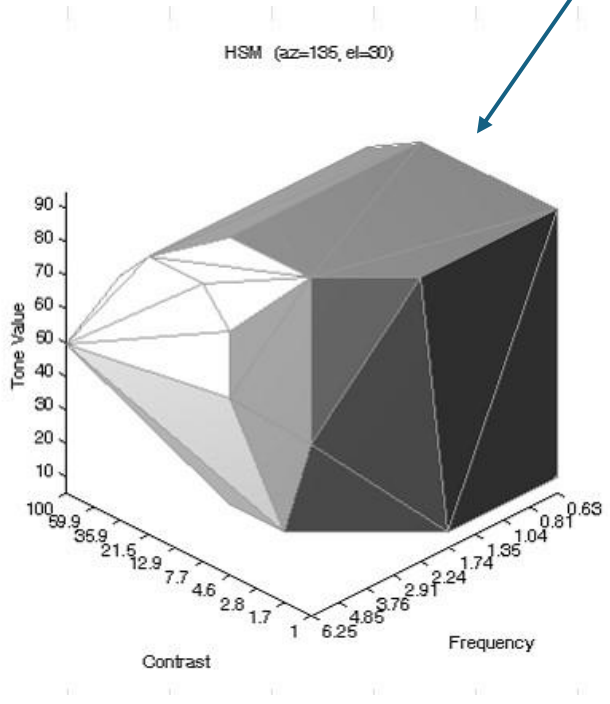
imagetestlabs.com

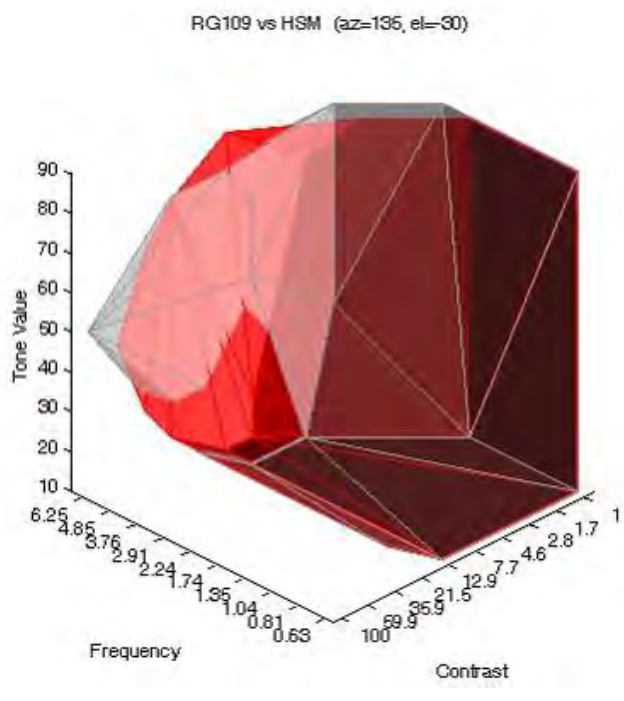
"Even my mother doesn't like my print quality!"

Imaging Volume Via Resolution Gamut

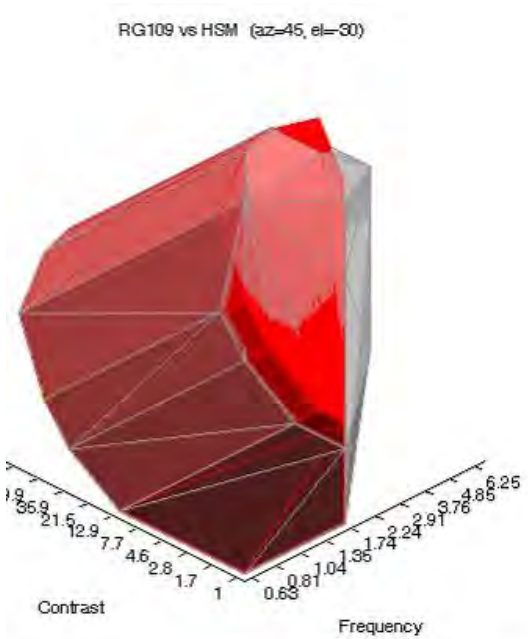
Comparing an Inkjet Press vs Offset Press Combined

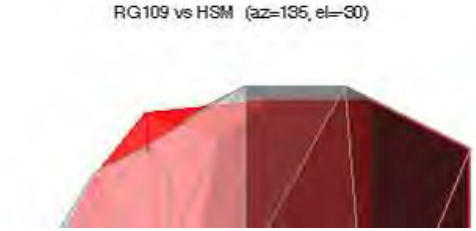


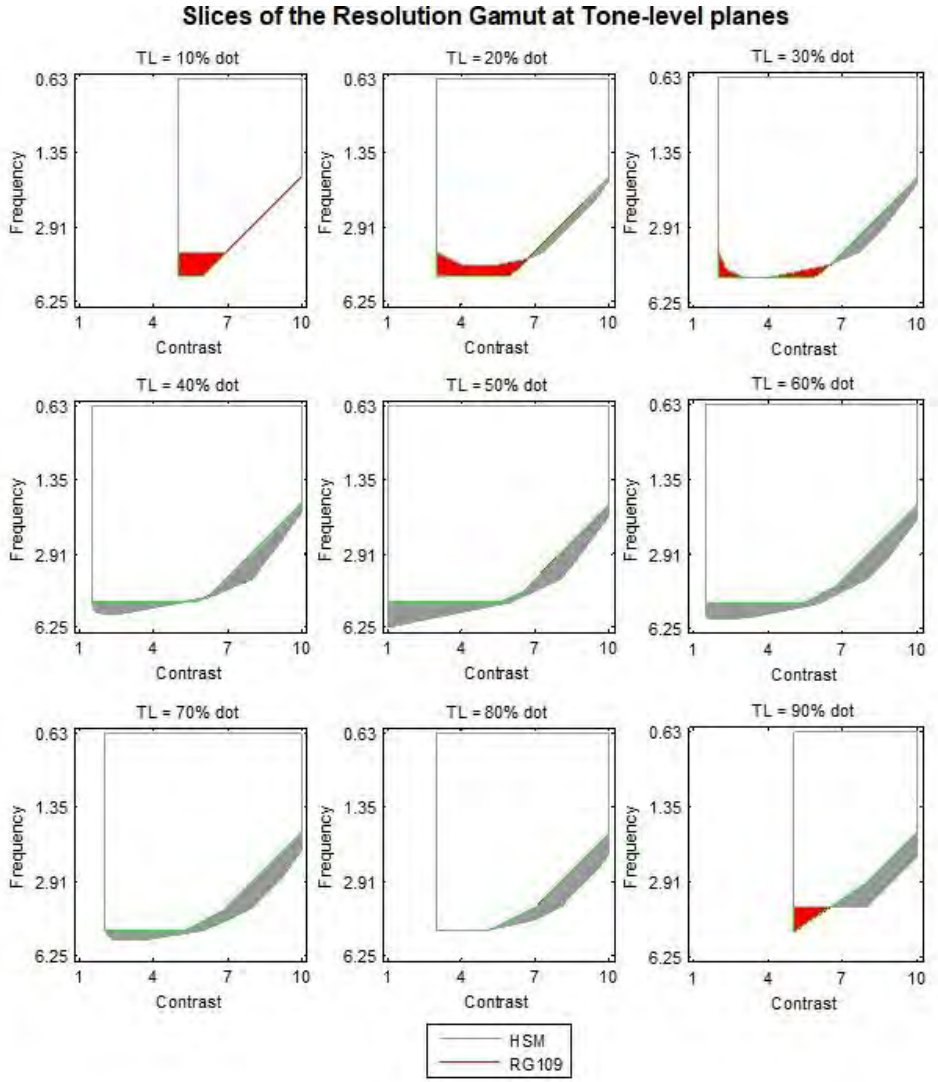




Slicing res gamut specific areas of interest.







Like a CAT Scan of press imaging volume.

Matching Offset with Dainippon Screen's InkJet Web Press 520HD

Amazing Press - DS has manufactured thousands of IJ Presses – Exceptional Dryer

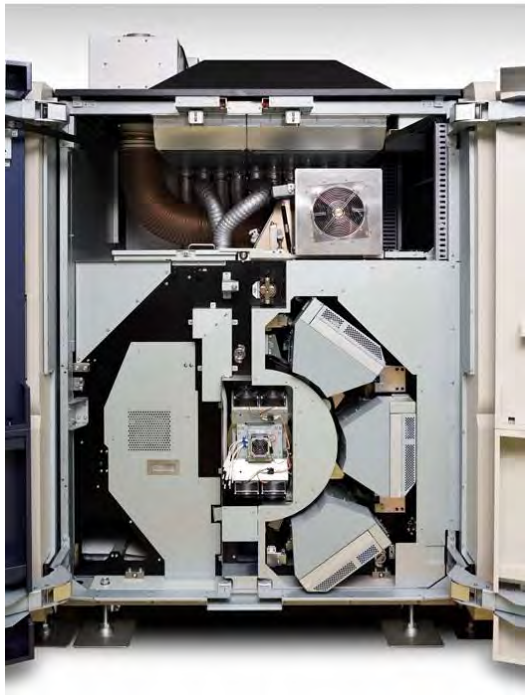
Great ink

Excellent RIP and Press Controls

Prints great.

You be the judge from the following data.

Takes 50 to 70 times more energy to dry IJ ink as it does to fuse toner.



Dryer is as important as IJ Heads and Ink

Match Test Page

Test Form for performing the match test.

Sterling
Ultragloss C2S
100# White Offset
New Page Paper

Test Patches

IJ Ink Perge Lines

Mil Spec 105 c Sampling of Run Imagery

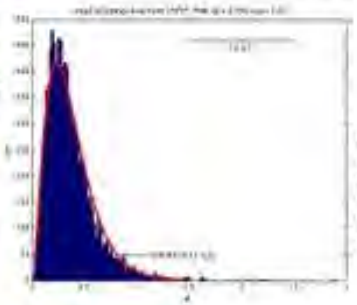
- **How it Works:**

- Determine the lot size and inspection level.
- Refer to the tables in MIL-STD-105 to determine the appropriate sample size and acceptance/rejection criteria.
- Select a sample from the lot and inspect the items.
- Compare the number of defects found in the sample to the acceptance/rejection criteria.
- Accept or reject the lot based on the comparison.

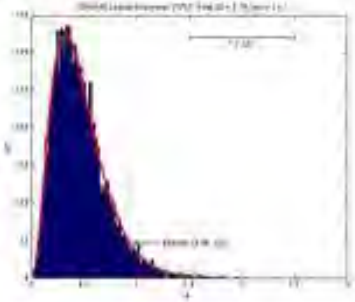
Color Stability – Inkjet vs Offset

67 samples across 750 sheet run – 144 colors per sample

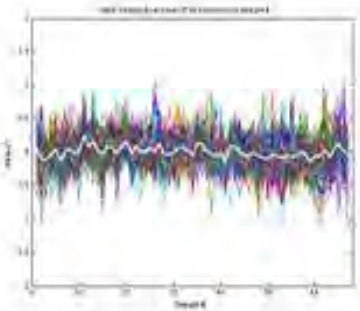
Delta E variations across the run for each color

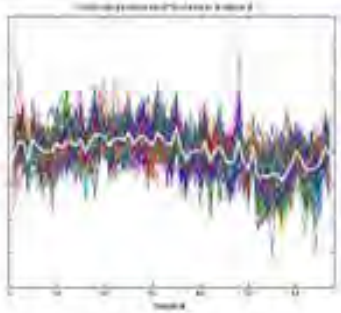


0.23		Peak ΔE	0.37
0.31		50% percentile	0.42
0.82		95% percentile	0.94



Time sequence of Delta E variations





Inkjet more stable than offset but differences below visual threshold

Significant Benefits of the SCREEN 520HD SC Press Derived from Stability and Consistency

1. Ability to economically produce a critical color image level over a long run length.
2. Ability to accurately predict the materials and processes used for the printed work.
3. Reduced paper waste on top of a 15-20% lower paper cost than a sheet fed offset press.
4. Faster get to color on press at makeready.
5. More accurate and fine-tuned price estimating to win more work.

Color Variability and Drift

The Inkjet run data trends shown in Figure 3 show little evidence of drift in either the envelopes of the individual measurements or in the averages over all color patches on a page

Offset

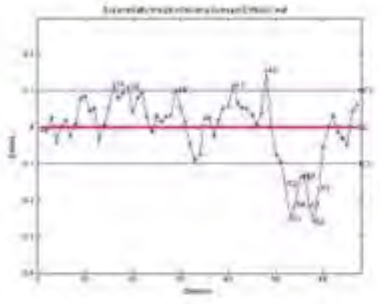


Figure 4a: Offset ΔL* EWMA chart

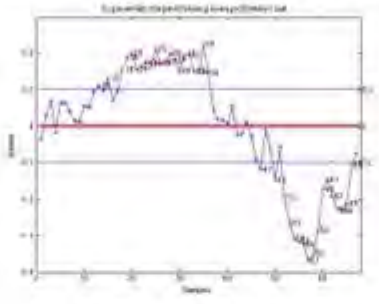


Figure 4b: Offset Δa* EWMA chart

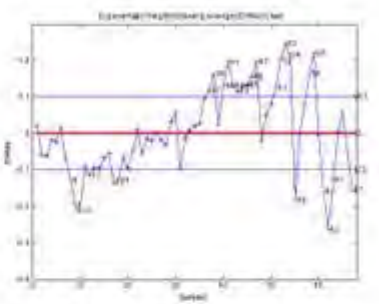


Figure 4c: Offset Δb* EWMA chart

InkJet

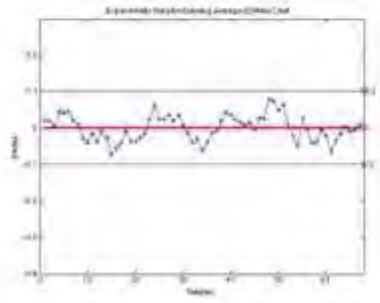


Figure 5a: Inkjet ΔL* EWMA chart

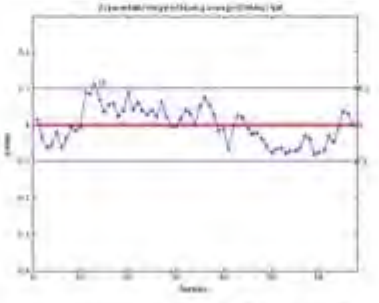


Figure 5b: Inkjet Δa* EWMA chart

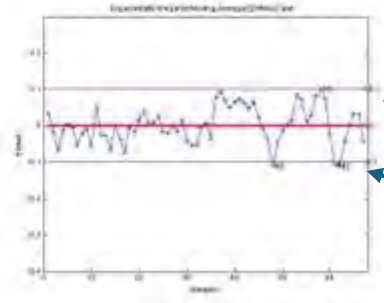


Figure 5c: Inkjet Δb * EWMA chart

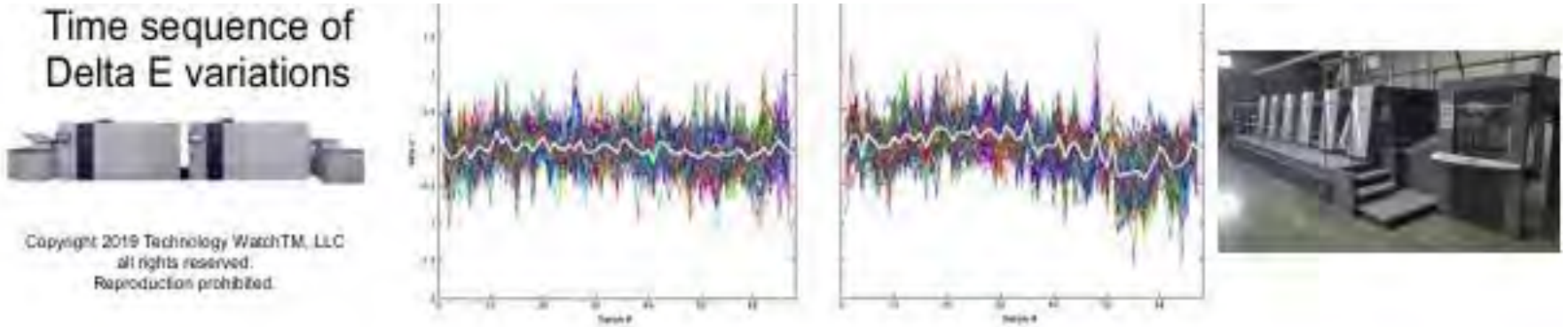
Inkjet press color variability was lower, and color consistency was higher, over the entire 16,000-foot press run than that observed in the matching offset run – with the two matching runs printed side-by-side on the same substrate

Upper/Lower Control Limits

Analysis In our analysis of the data from some 19,296 measurements of the inkjet press and offset press match runs, we evaluated color consistency capability from four different perspectives:

1. We looked at the entire mass of data and evaluated how the magnitudes of individual patch color variability were distributed. Color consistency advantages can be found in comparison of the two distribution shapes.

2. Conclusion: Inkjet press color variability was lower, and color consistency was higher, over the entire 16,000-foot press run than that observed in the matching offset run. (compare the histograms)



3. We looked at how color variability changed within the runs to evaluate press stability. Stability is required to achieve consistency in the reproduction of color. Conclusion: Measures of overall statistics as well as trends throughout a run show a clear inkjet press advantage in achieving consistent color reproduction

4. From our analysis of press stability, drift was identified as the major source of instability. Drift in the two press runs, one inkjet and the other offset, was examined with a very sensitive tool called EWMA.

Conclusion

Process Capability

All of the component process capability indices for controlling color variability in the inkjet press run are exemplary and better than the corresponding process capability indices for the offset press run.

Drift in Color Variability

The capabilities for controlling the mean variability and maintaining the consistency of the color reproduction process in the inkjet press run are clearly superior to the capabilities shown in the offset press run.

Extra Submission to TAGA for You

In addition to this presentation, we have also submitted a detailed report for you.

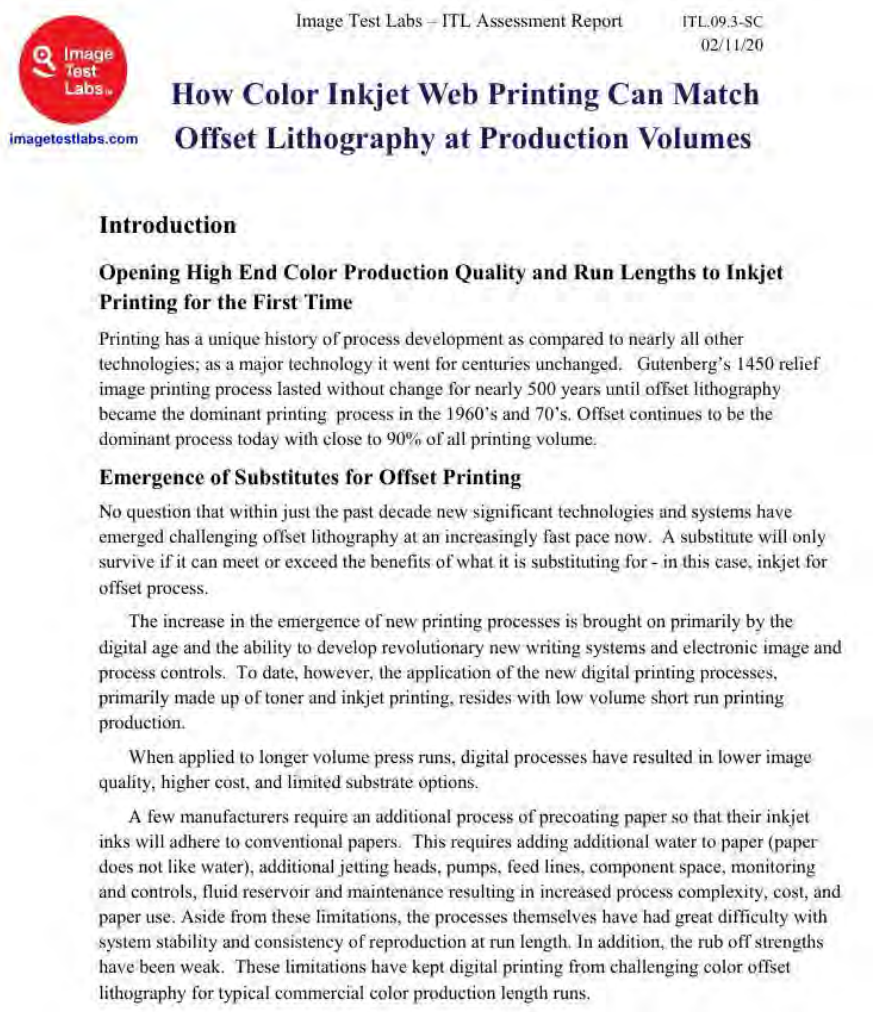


Image Test Labs – ITL Assessment Report ITL.09.3-SC
02/11/20

imagetestlabs.com

How Color Inkjet Web Printing Can Match Offset Lithography at Production Volumes

Introduction

Opening High End Color Production Quality and Run Lengths to Inkjet Printing for the First Time

Printing has a unique history of process development as compared to nearly all other technologies; as a major technology it went for centuries unchanged. Gutenberg's 1450 relief image printing process lasted without change for nearly 500 years until offset lithography became the dominant printing process in the 1960's and 70's. Offset continues to be the dominant process today with close to 90% of all printing volume.

Emergence of Substitutes for Offset Printing

No question that within just the past decade new significant technologies and systems have emerged challenging offset lithography at an increasingly fast pace now. A substitute will only survive if it can meet or exceed the benefits of what it is substituting for - in this case, inkjet for offset process.

The increase in the emergence of new printing processes is brought on primarily by the digital age and the ability to develop revolutionary new writing systems and electronic image and process controls. To date, however, the application of the new digital printing processes, primarily made up of toner and inkjet printing, resides with low volume short run printing production.

When applied to longer volume press runs, digital processes have resulted in lower image quality, higher cost, and limited substrate options.

A few manufacturers require an additional process of precoating paper so that their inkjet inks will adhere to conventional papers. This requires adding additional water to paper (paper does not like water), additional jetting heads, pumps, feed lines, component space, monitoring and controls, fluid reservoir and maintenance resulting in increased process complexity, cost, and paper use. Aside from these limitations, the processes themselves have had great difficulty with system stability and consistency of reproduction at run length. In addition, the rub off strengths have been weak. These limitations have kept digital printing from challenging color offset lithography for typical commercial color production length runs.

Much more Information is available.

Q&A

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