

HP T300 Color Inkjet Web Press Print Quality Analysis – Comparison with 133- and 175-line Offset

This report summarizes the testing and analysis of the current release of the HP T300 COLOR INKJET WEB PRESS [T300] in comparison with offset printing, considered the “gold standard” for commercial printing.

Offset lithography is a well-established technology that is applied in many market segments with appropriately tuned print quality. Offset is capable of extremely high quality applications such as fine art reproduction, and of modest quality for local newspaper printing – offset print quality offers an application-dependent performance range. For this study we have focussed on the book publishing, direct mail, and transactional/promotional (transpromo) printing application areas. Offset print quality for those applications may be characterized by 133-line and 175-line screening.

The Hewlett-Packard Company commissioned the *spencerLAB* DIGITAL COLOR LABORATORY to perform an initial independent comparison of the print quality of the T300 COLOR INKJET WEB PRESS with 133-line and 175-line Offset. HP anticipates further evaluations of their INKJET WEB PRESS capabilities.

EXECUTIVE SUMMARY

SpencerLAB analysis found that **the print quality of the tested T300 with ColorPRO media is comparable overall to 175-line uncoated Offset; with commercially available plain paper (without any optimization), T300 print quality is generally comparable to 133-line uncoated Offset; and with coated media, print quality of the T300 exceeds 175-line coated Offset in some areas.**

The tested T300 print quality is more than acceptable for most of the targeted markets of book publishing, direct mail, and transactional printing. Its speed of up to 400 feet/minute, up to 30-inch wide web, and ability to use standard plain paper add significantly to its value.

KEY FINDINGS

Important attributes of the T300 print quality are its rendition of realistic memory colors for image reproduction, smooth Tints & Blends, and rich blacks for easier legibility, important in the targeted market segments. Of course, not having the 2400² dpi capability of Offset imposes some limitations, especially on Text & Lines.

TINTS & BLENDS AND IMAGES were an impressive area for the T300. Tints & Blends on

the T300 ColorPRO and coated prints were comparable overall to 175-line Offset on corresponding media; ColorPRO image quality was even higher. Although richness was limited (except on ColorPRO), memory colors were more realistic than Offset, on all media.

TEXT & LINE rendition was smoother on the T300, with excellent registration. Text and Lines were legible and rendered without the distractive screening and misregistration seen in 133-line and even 175-line Offset in non-primary/secondary colors and grayscale. In comparison, primary/secondary color and black Text & Lines were slightly thicker with less edge sharpness, an advantage of Offset's higher resolution.

COLOR GAMUT AND BLACK DENSITY. Gamut volume was 24% larger on T300 ColorPRO output, with significantly larger blue and green regions. Uncoated gamut volumes were comparable; however coated Offset gamut volume was larger than the coated T300. Black density was higher on the T300 than on Offset across all media. T300 ColorPRO output density was 1.39 ODU, nearly 40% higher than uncoated Offset; and on coated media, T300 density was 1.50 ODU while Offset was 10% lower.

The same standard, untreated plain media, Domtar Lynx Opaque Ultra (60# text), was used on both T300 and Offset without any optimization. The T300 was also tested with ColorPRO (60# text) uncoated media. The T300 and Offset were further tested with coated media: Utopia Inkjet (60# text, matte finish) for the T300 and comparable Utopia Two (60# text, matte finish) for Offset.

Research to identify a high-level offset printer led us to a Heidelberg Speedmaster 74 sheet-fed offset press with a Kodak/Creo 5080 Trendsetter VLF Quantum platemaker at the Print Applications Laboratory of the Rochester Institute of Technology. Printing at 133-line and 175-line screening was supervised on-site by *spencerLAB* personnel. Printing on the T300 was also supervised by *spencerLAB* personnel at two T300 sites in order to assure representative output. All test printing on the T300 was at 400 feet per minute.

Print quality was analyzed comparatively by a team of experienced *spencerLAB* analysts – with emphasis on the intended book publishing, direct mail, and transactional markets – noting the areas of TEXT & LINES, TINTS & BLENDS, IMAGES, and COLOR GAMUT & BLACK DENSITY, all on appropriate media.

Two-dimensional COLOR GAMUT and BLACK DENSITY plots were created with measurements from an X-Rite 939 Spectrodensitometer. COLOR GAMUT volume was tested using a 384-patch CMY, 0% GCR/UCR file with media color management.

Just prior to release of this report, we had the opportunity to run the T300 with HP High-speed Glossy Coated Paper. A limited print quality analysis was performed, and results are presented at the end of this report.

RESULTS OF ANALYSIS

TEXT & LINES

Text and Lines are the most common elements of a document, and should communicate information to the audience in a clear and appropriate, yet unobtrusive way, so as not to compromise the document's value. Text should be rendered cleanly and legibly. Lines must be smooth, sharp, and well defined for the document to maintain its professional appeal.

Text

Uncoated Media

Black text was bolder on T300 ColorPRO and uncoated output than both 133- and 175-line Offset output. Bolder black text creates easier legibility. T300 black text was smooth at normal viewing distance. Offset black text was crisper, but looked faded in comparison with T300 ColorPRO output. Black text on the T300 and Offset output maintained good legibility even down to 2-point size although, minor dropouts were noticed on T300 at 6-point and below. T300 text appeared slightly soft under magnification while Offset text remained sharp. Black text on the T300 output was rendered with good overall quality.

Color text is used to highlight key points in a document and to draw the readers' attention. T300 and Offset color text maintained the characteristics of the black text comparison. However, T300 color text had minor dropouts starting at 8-point and minor ink spray visible only under magnification. In comparison, while Offset prints were also legible down to 2-point, in most colors (any that contained less than 100% of any C, M, Y, or K components; e.g., pink, orange, or brown as well as gray) a screening pattern was noticeable, especially on 133-line output. This screening pattern could be distracting and unappealing in larger size text for headings or marketing slogans. Minor yellow misregistration was also visible under magnification on Offset color text, while T300 prints maintained excellent registration with non-primary text being highly legible. Offset color text was rendered sharp, but distractive screening on 133-line Offset detracted from overall print quality. The T300 ColorPRO and uncoated output had comparable color text print quality. The T300 color text was overall comparable to 133-line Offset.

Reverse text, although less common, maybe used in various applications for emphasis in lieu of, or in addition to color. Smaller sizes are often bold. Reverse black and color text on T300 output was legible down to 4-point size, with 2-point almost filled-in and minor fill-ins noticed below 14-point size on fine serifs. Although reverse black and color text on Offset prints were legible down to 2-point size and were free of minor fill-ins down to 2-point, misregistration on Offset reverse color text made legibility difficult. T300 prints maintained superb registration.

12-point Text Comparison Examples (*Color Spectrum* extract)

<p>Offset - Coated - 133-line</p>	<p>T300 - Coated</p>	<p>Offset - Coated - 175-line</p>
<p>Offset - Uncoated - 133-line</p>	<p>T300 - Uncoated</p>	<p>Offset - Uncoated - 175-line</p>

Coated Media

Coated media had similar black and color text characteristics as the uncoated media. T300 black text was rendered with good quality and appeared crisp at normal viewing distance with slightly bolder black text rendition than Offset output. Under magnification the T300 appeared slightly soft while Offset maintained its crispness. The T300 output displayed black text that was rendered with overall good quality.

T300 color text was smooth and legible. Offset prints had color text legible down to 2-point; however, in most colors a screening pattern was noticeable, especially on 133-line output. Offset color text was crisp, but distractive screening on 133-line Offset detracted from overall print quality. Under magnification, T300 color text appeared

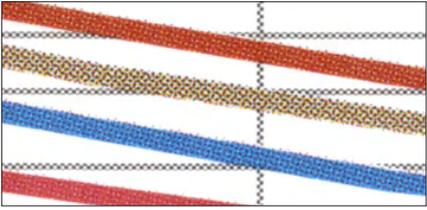
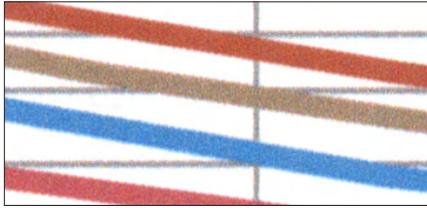
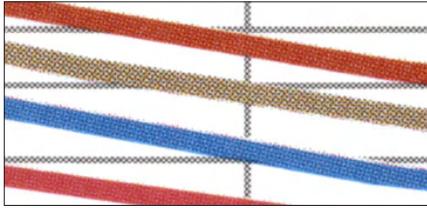
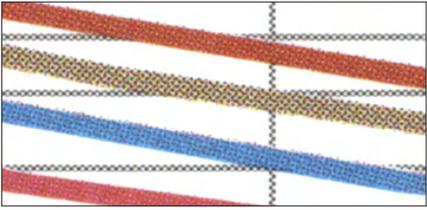
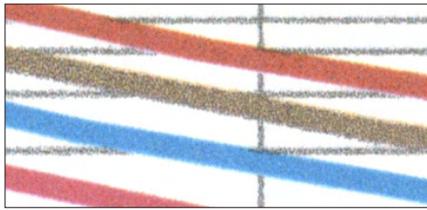
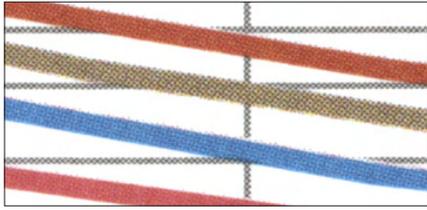
slightly soft with minor ink spray. The T300 output was overall comparable to 175-line Offset color text.

Reverse black and color text had similar characteristics as uncoated media. Reverse text on the T300 output was legible down to 4-point size, with 2-point mostly filled-in. Offset prints were legible down to 2-point size. Misregistration was noticed on Offset reverse color text making legibility difficult, while the T300 prints maintained excellent registration.

Lines

Applications typically use Lines as rules and in call-outs as well as in computer graphic illustrations that require clean and crisp Line rendition. Use of Lines is frequent in transpromo documents, and some commercial applications may involve use of complex line illustrations.

Lines Comparison Examples (*Color & Print Quality extract*)

		
Offset - Coated - 133-line	T300 - Coated	Offset - Coated - 175-line
	 	
Offset - Uncoated - 133-line	T300 - ColorPRO T300 - Uncoated	Offset - Uncoated - 175-line

Uncoated Media

As with black text, black lines were bolder on the T300 ColorPRO output than on both 133- and 175-line Offset output, as well as on T300 uncoated output. T300 uncoated and ColorPRO output were smooth at normal viewing distance, but under magnification showed minor jaggedness, especially on curved lines. T300 black line rendition was uniform, with minor loss of fine line detail. Offset output was sharp with smooth curved lines, but looked faded in comparison with T300 ColorPRO output. Overall, the T300 black line quality was acceptable for the stated resolution.

Solid primary and secondary color lines were similar to black line characteristics on the T300 and Offset media prints. Screening was noticeable on T300 and both Offset output. Although Offset color lines were sharper than the T300, screening on 133-line was noticeably distracting. Very fine color and gray lines, appeared broken or dotted on both Offset and T300 prints. Minor yellow misregistration was also visible on 133-line Offset, while T300 color lines maintained excellent registration.

Coated Media

Black and color lines had similar characteristics on coated media as on the uncoated media. T300 black and color lines were smooth at normal viewing distance. T300 black lines were slightly bolder than Offset but less crisp. Offset black and color lines were sharp, with smooth curved lines. Minor screening was noticeable on T300 and 175-line Offset, however coarse screening on 133-line Offset was distracting. Very fine color and gray lines appeared broken or dotted on both Offset and T300 output.

As with text, the quality of black and color lines on the T300 uncoated and coated output has relative strengths and limitations, with coated color lines comparable to 175-line Offset; overall they were fully acceptable for the target markets.

TINTS & BLENDS

Tints are large areas of a single color that are sensitive to artifacts and graininess – they should be smooth and uniform. Blends are transitions between two or more Tints, whether from highlight to shadow or between different hues – they too should be rendered smoothly without showing harsh steps from highlight-to-shadow or from

Color Tint Comparison Examples (*Color Graphic* extract)

Offset - Coated - 133-line	T300 - Coated	Offset - Coated - 175-line
Offset - Domtar Lynx - 133-line	T300 - Domtar Lynx	Offset - Domtar Lynx - 175-line

color-to-color. Tint smoothness and uniformity depend primarily on the printing engine or mechanism, while blend smoothness depends more upon the adjacent color-to-color processing of the DFE/RIP.

As the use of color in printing increases, more and more innovative ideas are being implemented by document creators. Efficient use of Tints & Blends can help enhance the overall appeal of a document and add value by enhancing visual appeal – color has been shown to significantly increase direct marketing response rates.

Uncoated Media

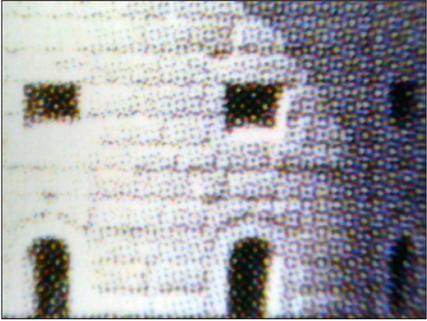
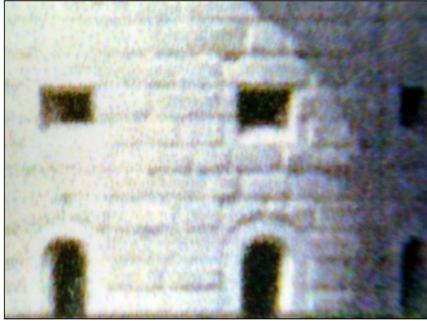
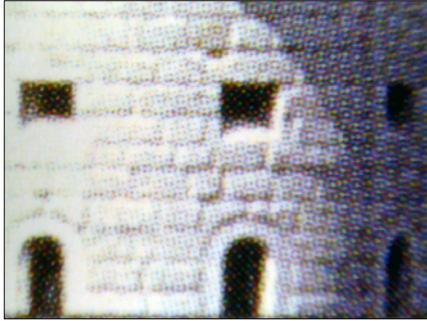
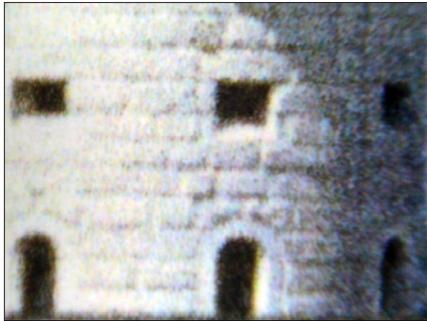
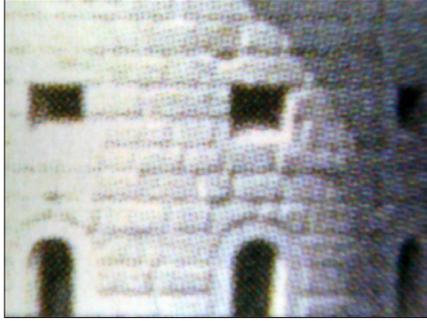
Color tints on the T300 ColorPRO output appeared more saturated than on the T300 uncoated output. T300 ColorPRO output was well saturated in the blues, greens, and yellows, although less than Offset in the reds. Screening patterns were noticeable on both Offset output and minor graininess was noticed on T300 prints. The screening pattern was less noticeable on 175-line Offset output than 133-line output, where it was distracting. T300

ColorPRO tints were smoother than 133-line output tints.

T300 ColorPRO tints had better print quality than color tints on the T300 uncoated output; Domtar Lynx uncoated T300 output displayed mottling in dark tints, resulting in its color tints to be judged closer to 133-line Offset output quality. Overall, color tints on the T300 ColorPRO output were comparable to 175-line Offset quality.

Color highlight-to-shadow blends on T300 ColorPRO and uncoated prints were rendered smoothly overall, comparable to 175-line Offset. Color-to-color blends on the T300 were rendered smoother than both Offset output. T300 Domtar Lynx uncoated color-to-color blends were comparable to 133-line Offset quality, with mottling and less saturation in dark blue areas, however other colors did not suffer. Overall, T300 output was extremely smooth while 133-line Offset had distracting screening. T300 ColorPRO was comparable to Offset 175-line output.

Image Comparison Examples (Castle extract)

		
Offset - Coated - 133-line	T300 - Coated	Offset - Coated - 175-line
		
	T300 - ColorPRO	
Offset - Uncoated - 133-line	T300 - Uncoated	Offset - Uncoated - 175-line

Coated Media

T300 coated output had smooth color tints & blends. Tints & blends were well saturated on the T300, but less saturated than Offset. Minor graininess was noticed on the T300 prints, while screening patterns were noticed on Offset output, less so on the 175-line than on the 133-line output, which was distracting. Overall, color tints on T300 output were comparable to 175-line Offset quality.

T300 highlight-to-shadow blends became less saturated as they approached the shadows. However, Offset coated output had harsh transitions in blue highlight-to-shadow blends. T300 output had visible grain in the orange-to-lime (green) and near-cyan areas of color-to-color blends. Offset 133-line output showed a noticeable screening pattern, especially in the orange-to-lime blend. T300 color-

to-color blend quality was more than acceptable for the target markets.

Tints & blends on the T300 ColorPRO and coated prints were comparable to 175-line Offset on corresponding media.

IMAGES

Images – the visual perception of ideas and products – are used to more effectively communicate a message to the audience, “...worth a thousand words”. Often it is the Images on a page that command the readers’ first attention.

Image print quality is most important – images must be rendered pleasingly with realism, richness, sharpness, and lack of defects to most effectively deliver their value. They need to be rendered with the right balance of contrast, highlight & shadow detail, color, and definition.

Uncoated Media

Overall, T300 ColorPRO images were higher quality than 175-line Offset. T300 uncoated images were above 133-line Offset print quality and approached 175-line Offset quality.

T300 ColorPRO and uncoated output had similar characteristics in images as in color tints. T300 ColorPRO images were more saturated than T300 uncoated images. Images on Domtar Lynx uncoated paper displayed mottling in dark tints and shadow regions. Overall the T300 ColorPRO images had higher print quality than the T300 uncoated output.

T300 color management resulted in extremely realistic color images. Memory colors – blue skies, water, and green foliage – were more realistic on T300 images, whereas Offset images had a magenta cast in blue skies and water and green foliage appeared yellow and desaturated. In comparison with Offset, T300 Domtar Lynx output was slightly grainier in some tones, less saturated, and exhibited some mottling in black. However, T300 ColorPRO images had skin tones that were more realistic than Offset, which had a yellowish cast. T300 ColorPRO images also appeared rich and vibrant compared to Offset, with better shadow detail and image depth. Highlight detail on T300 ColorPRO was better than 133-line, but not as good as 175-line Offset. Offset had a distracting screening pattern, especially on 133-line output. T300 image definition was comparable to 175-line Offset. For example, discerning individual bricks on the right of the middle *Castle* window [previous page] was difficult on the 133-line Offset, but clear on the T300 and 175-line Offset output.

Monochrome images on T300 ColorPRO output had better print quality than even 175-line Offset, with richer blacks, good image depth, and shadow detail. Offset monochrome images looked flat and washed out in comparison. T300 output on Domtar Lynx uncoated paper showed mottling in shadow regions, lowering image quality to be overall comparable to 133-line Offset output.

Coated Media

T300 color management resulted in extremely realistic image rendition on coated media, as with uncoated media. Offset output had a magenta cast on blue skies and water, skin tones appeared slightly orange, but unlike uncoated media the green foliage was not desaturated. The

T300 output had comparable saturation, image depth, and shadow detail to Offset output. T300 coated output displayed smooth skies and skin tones, while distracting screening on 133-line Offset images lowered their overall print quality. T300 image definition was higher than 133-line output, with Offset 175-line output still higher. Overall, T300 images were above the 133-line Offset print quality and comparable to 175-line Offset quality.

Monochrome images on T300 coated media had richer blacks than Offset and better shadow detail with less image definition in some images. Coated T300 monochrome images were overall comparable to coated 175-line Offset images.

COLOR GAMUT VOLUME & BLACK DENSITY

Gamut Volume

Gamut Volume of a printer refers to the range of colors the device can produce. Be it a desktop printer, a digital press, or a commercial Offset press, larger gamut means more producible colors and the ability to attain better differentiation of close colors on output.

Gamut volume measurements utilized a CMY test methodology that did not trigger the T300 color management in the same manner as did the *spencerLAB* RGB test images (which demonstrated good richness, color depth, and shadow detail). Based on these images we think the T300 may actually be rendering larger gamut volumes than measured with the CMY gamut volume methodology. Further enhancements to color management should also be able to take advantage of the device's larger raw gamut.

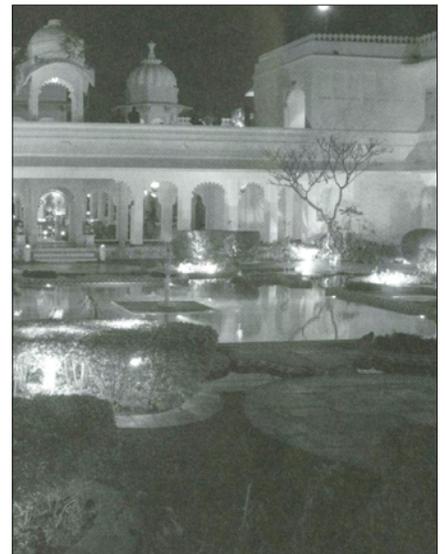
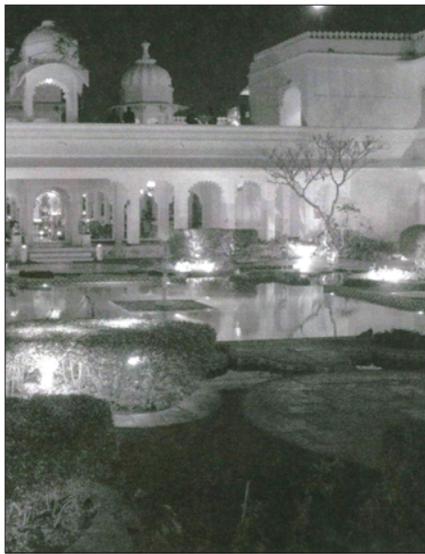
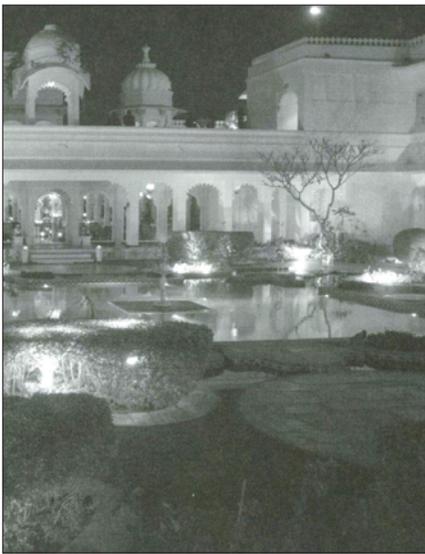
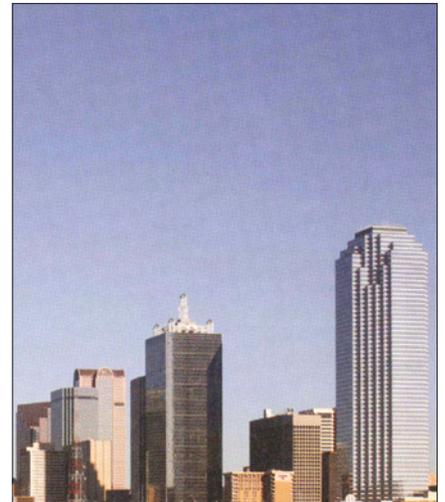
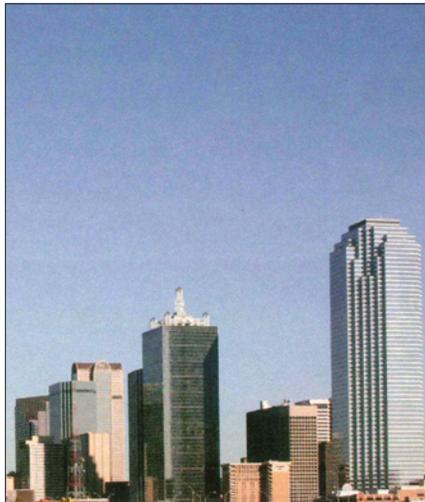
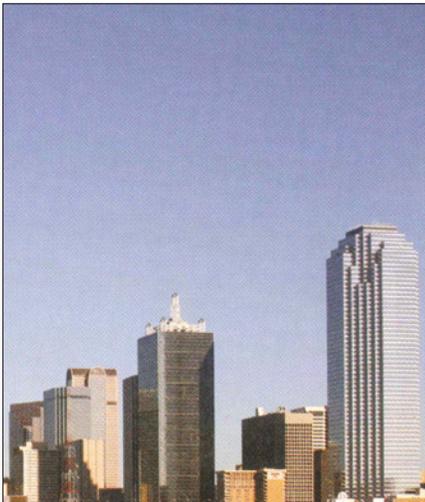
Uncoated Media

The tested color gamut volume of the T300 ColorPRO output was larger than uncoated Offset by approximately 24%. The tested T300 ColorPRO gamut was larger than uncoated Offset in the blue, green, and yellow regions – all areas other than the red region, wherein it was smaller, as seen in the two-dimensional graph on page 10.

The tested T300 uncoated gamut was comparable to uncoated Offset, with less gamut in reds and slightly more gamut in greens, as seen on page 10.

T300 ColorPRO output had a larger color gamut volume than the T300 uncoated output. ColorPRO gamut

Image Comparison Examples – Coated Media



Offset – 133-line

T300

Offset – 175-line

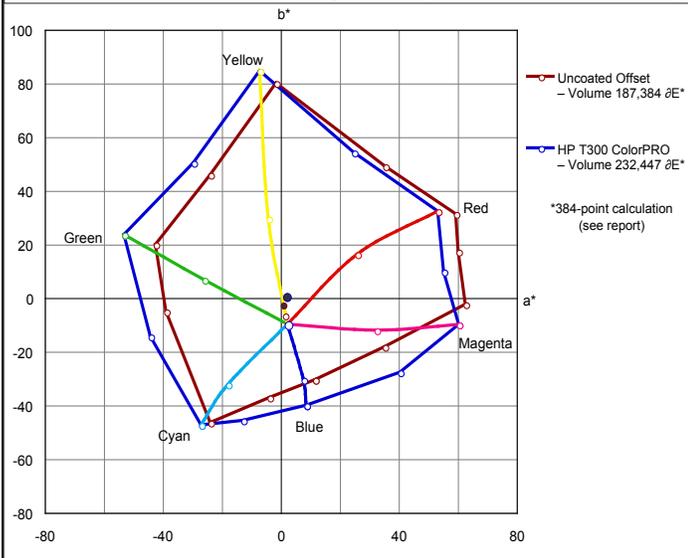
volume was more than a third larger. ColorPRO color gamut was larger in all color regions, shown on page 10.

Coated Media

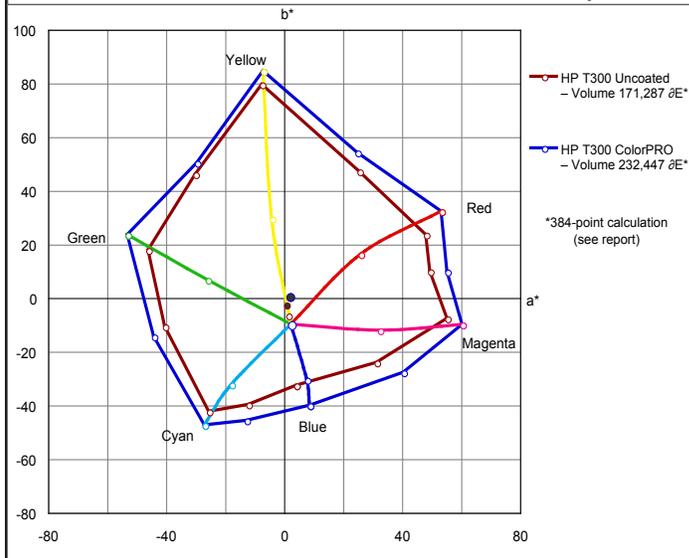
The tested color gamut volume of the T300 coated was 23% smaller than Offset. The difference was primarily

in the red and magenta, while the T300 was similar to Offset in all other areas. As noted previously, the gamut volume test methodology did not trigger the T300 color management in the same manner as did the *spencerLAB* test images (which demonstrated good richness, color depth, and shadow detail, as in the above examples).

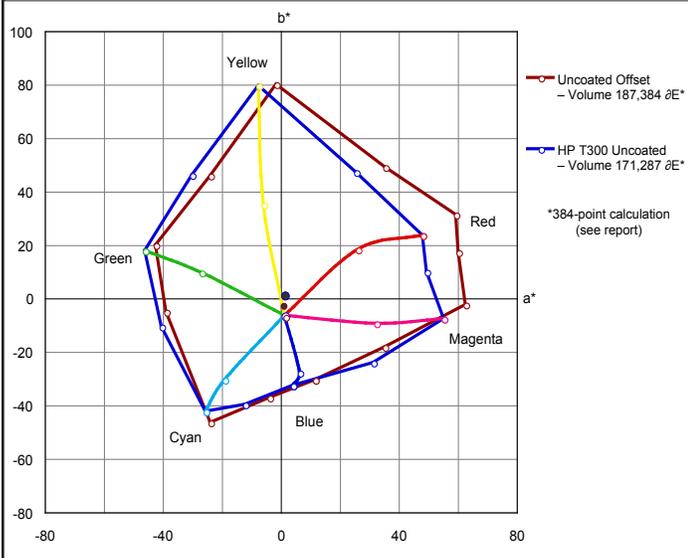
T300 vs Offset Gamut Comparison (ColorPRO vs. Uncoated)



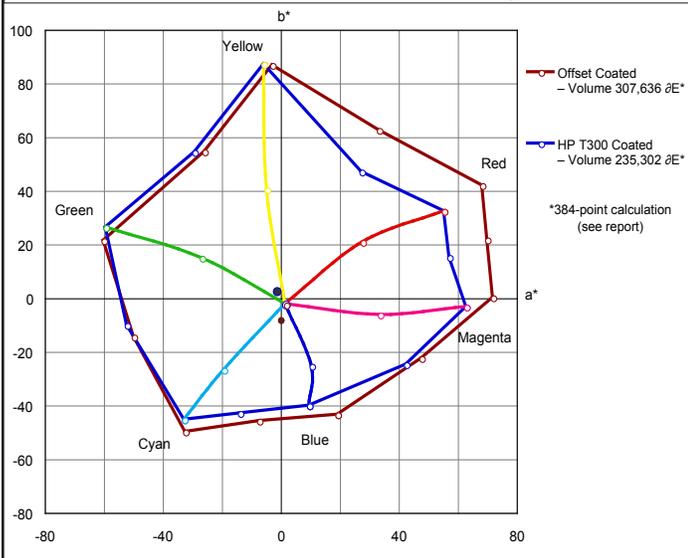
T300 Uncoated vs. ColorPRO Media Gamut Comparison



HP T300 vs Offset Uncoated Gamut Comparison



T300 vs Offset Coated Gamut Comparison



Black Density

High Black Density offers better impact on text, lines and images. It makes the black text and lines appear rich and more visible, and allows better highlight and shadow detail in images. The higher contrast and easier legibility of text facilitates effective communication.

Our most significant finding in this area was the outstanding black density achieved by the T300 on both coated and uncoated media; the T300 had higher black density than Offset on all media comparisons.

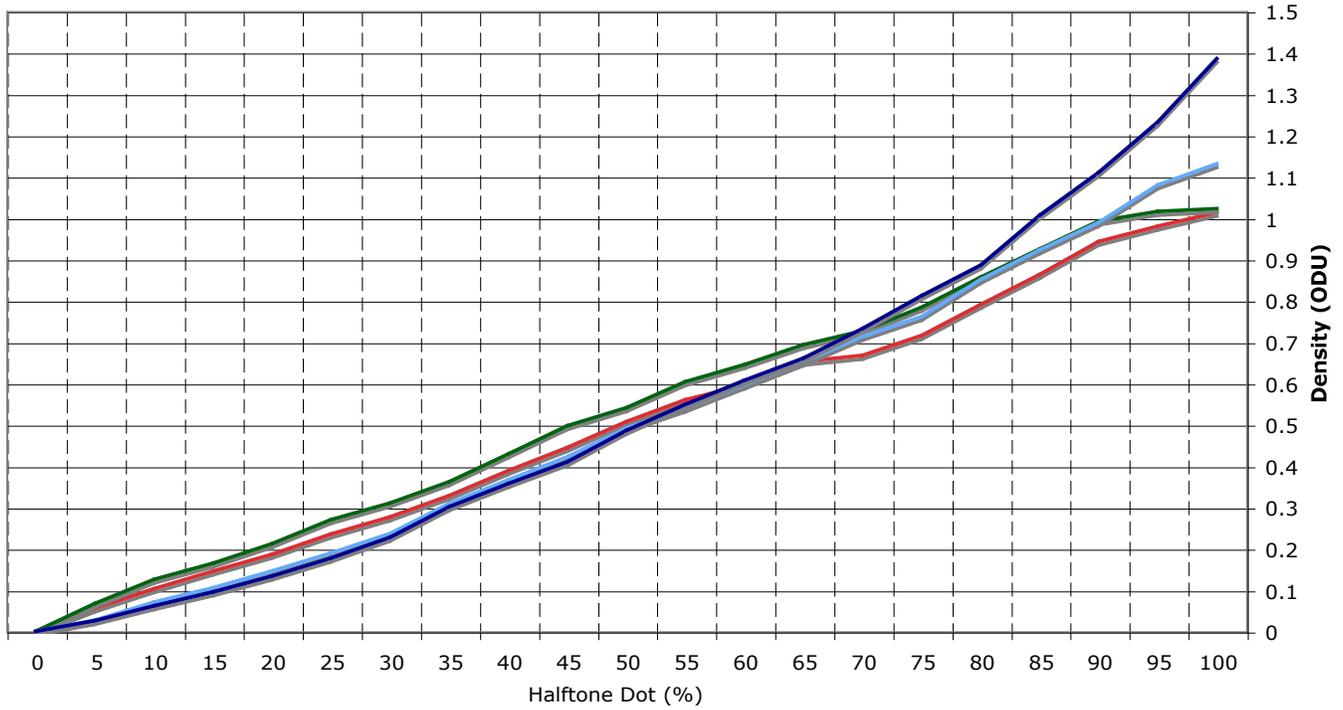
On the ColorPRO media, T300 black density was 1.39 ODU. This was almost 40% higher than the 133-line and 175-line uncoated Offset prints (1.02 and 1.01 ODU, respectively). On uncoated media, T300 also achieved higher black density than Offset prints with 1.13 ODU.

The black density achieved by the T300 on coated media was 1.50 ODU, 11% higher than either 133- or 175-line coated Offset.

Black density graphs are shown on the following page.

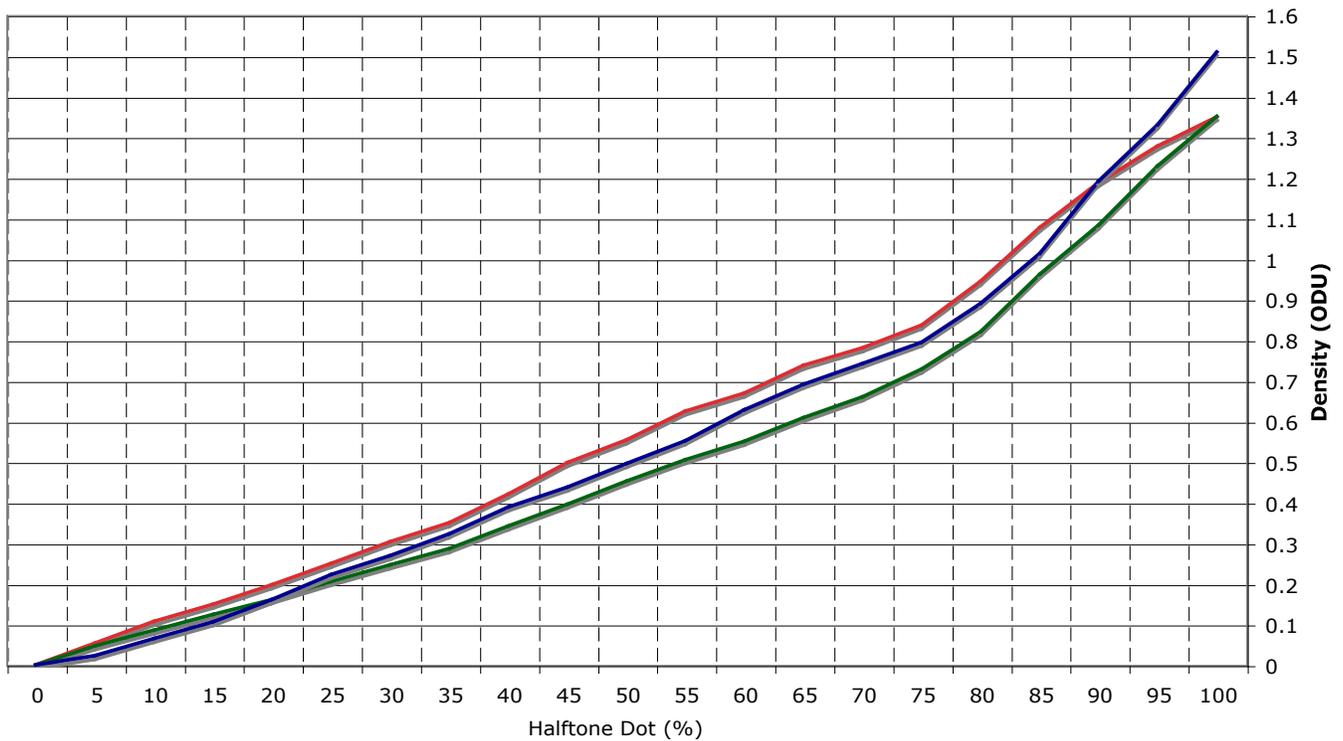
Black Density - Uncoated Media

— Offset 175 - Lynx Opaque Ultra — Offset 133 - Lynx Opaque Ultra
— HP Web Press - Lynx Opaque Ultra — HP Web Press - ColorPRO



Black Density - Coated Media

— Offset 175 - Utopia Two — Offset 133 - Utopia Two — HP Web Press - Utopia Inkjet



GLOSSY COATED MEDIA

In addition to the ability to print on any uncoated paper, the T300 is capable of printing on a range of coated media. Just prior to the release of this report, *spencerLAB* was able to run the T300 with HP High-speed Glossy Coated Paper (122# text) and perform a limited Print Quality comparison with Utopia Inkjet (60# text, matte finish) output.

Overall, the glossy paper output had bolder blacks, higher saturation, and better image shadow detail than the matte coated media output, and was comparable on other attributes. Under magnification, mud cracking was visible in blacks and saturated colors. As on all other tested media, registration was exemplary.

T300 black text on glossy output had similar characteristics as black text on matte coated output; including good legibility and crisp character rendition at normal viewing distance. The glossy black and color text were rendered bolder and more saturated than that of the matte coated media, but slightly softer in comparison.

Black and color lines on glossy and matte coated media were overall comparable, with glossy black lines slightly sharper.

Color tints were smooth on both the T300 glossy and matte coated output. T300 glossy media color tints improved saturation in blue, cyan, and green; while coated matte output was slightly more saturated in red and orange. Solid black tints were darker on the glossy media.

T300 glossy and matte coated output had smooth highlight-to-shadow blends, but glossy media maintained higher saturation in the shadows. Similar to matte coated media, color-to-color blends displayed minor grain in the orange-to-lime (green) and near-cyan areas on glossy media, but color-to-color blends improved in saturation from green-to-blue.

As on all other media, T300 glossy output images had extremely realistic color rendition - with color realism further enhanced in some areas, including blue skies and water and green foliage. T300 glossy output also had better shadow detail than matte output, however some images on matte media appeared to have higher definition. Overall, images on T300 matte and glossy media were comparable, confirming the T300's ability to print on media ranging from standard plain paper to glossy coated stock.

THE *spencerLAB* DIGITAL COLOR LABORATORY

The *spencerLAB* DIGITAL COLOR LABORATORY is an independent printer evaluation laboratory that provides services to vendors and corporations for whom digital color printing is mission-critical. The Laboratory follows strict guidelines in the integrity of both methodology and reporting; vendor-sponsored studies do not guarantee favorable results. *SpencerLAB* has developed industry-standard test software, and performs print quality, cost-per-page, speed, and ease-of-use analyses in all technology classes, from desktop printers to digital color presses.

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PRINT QUALITY TESTED