A New Topography Measurement Using Modified Scanner & Results Correlation to Print Mottle

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Topography

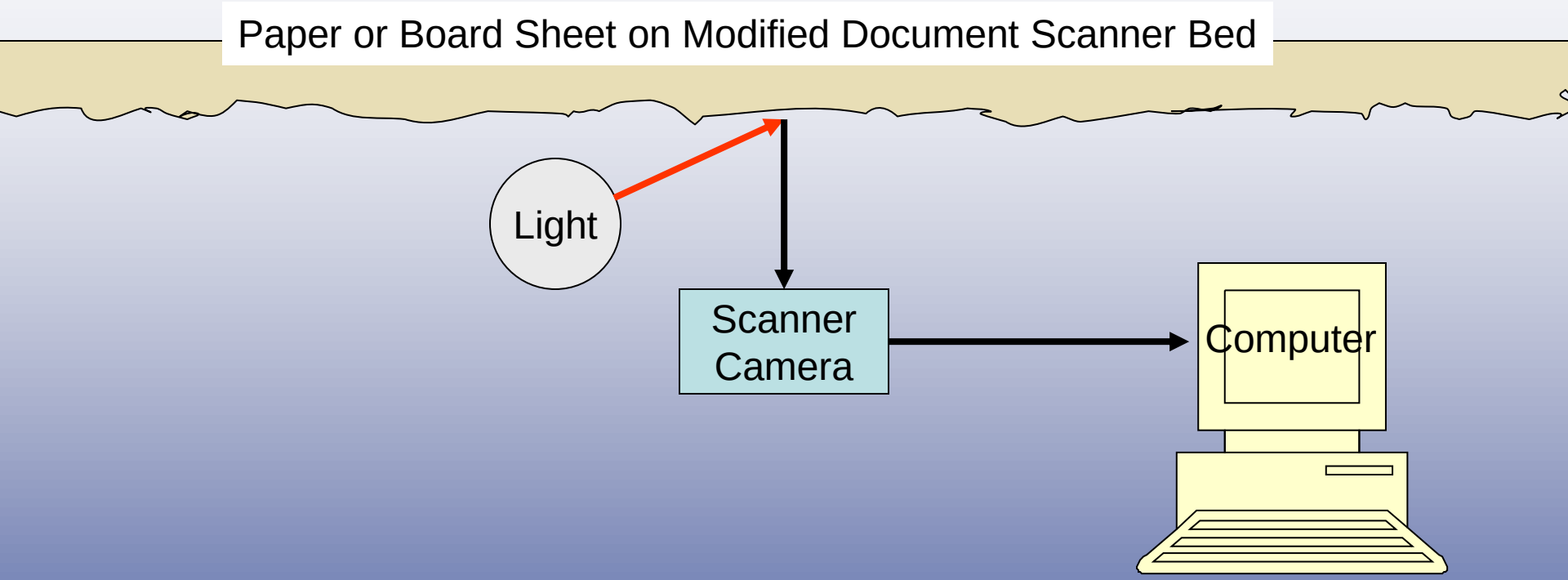
What is Optical Surface Topography Measurement?

- How it works.
- The instrument.
- Some Examples.
- Color Extraction – UV Brighteners.

How does it compare to other instruments that are supposed to yield measurements that correlate to printability?

How does Verity IA Topography correlate to Web Offset Print Mottle?

How it works:

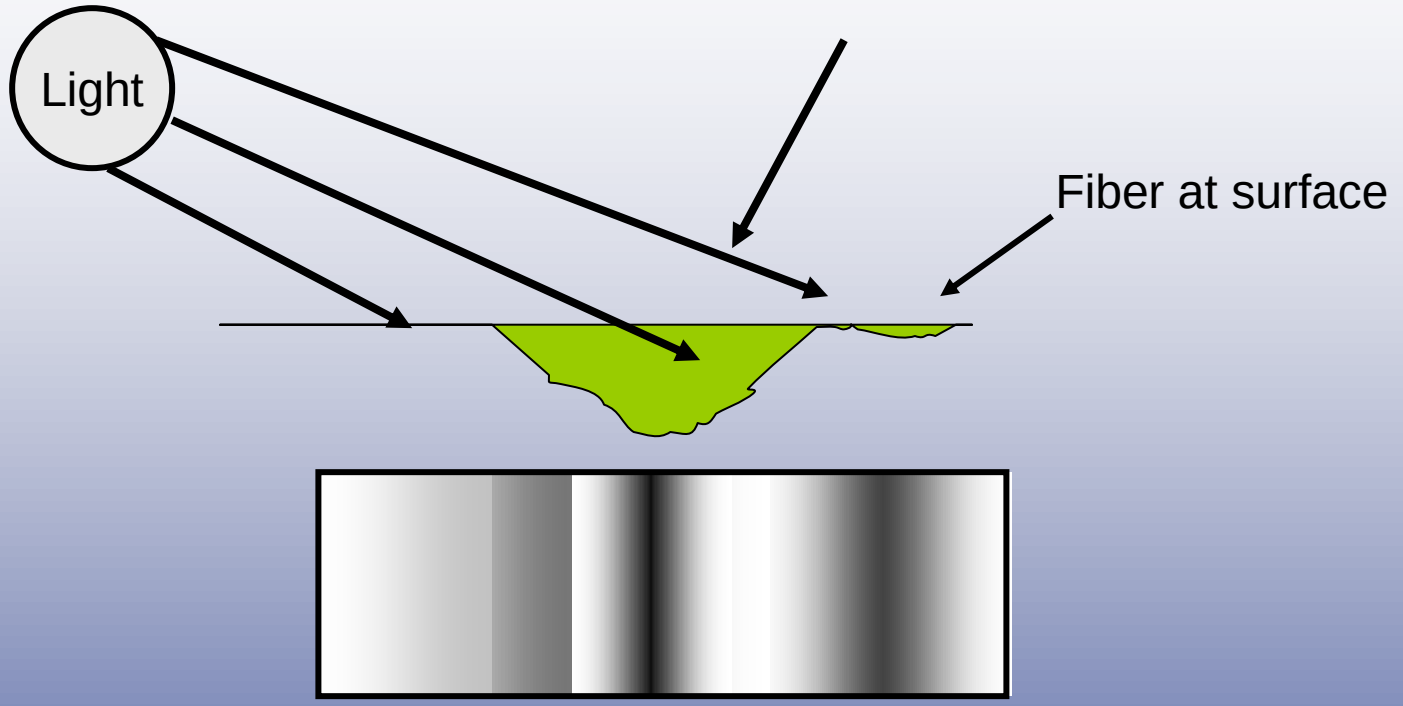


Integration of surface roughness and optical reflectivity of the surface itself.

Both contribute to printability as measured by Print Mottle.

Integration of surface roughness and optical reflectivity

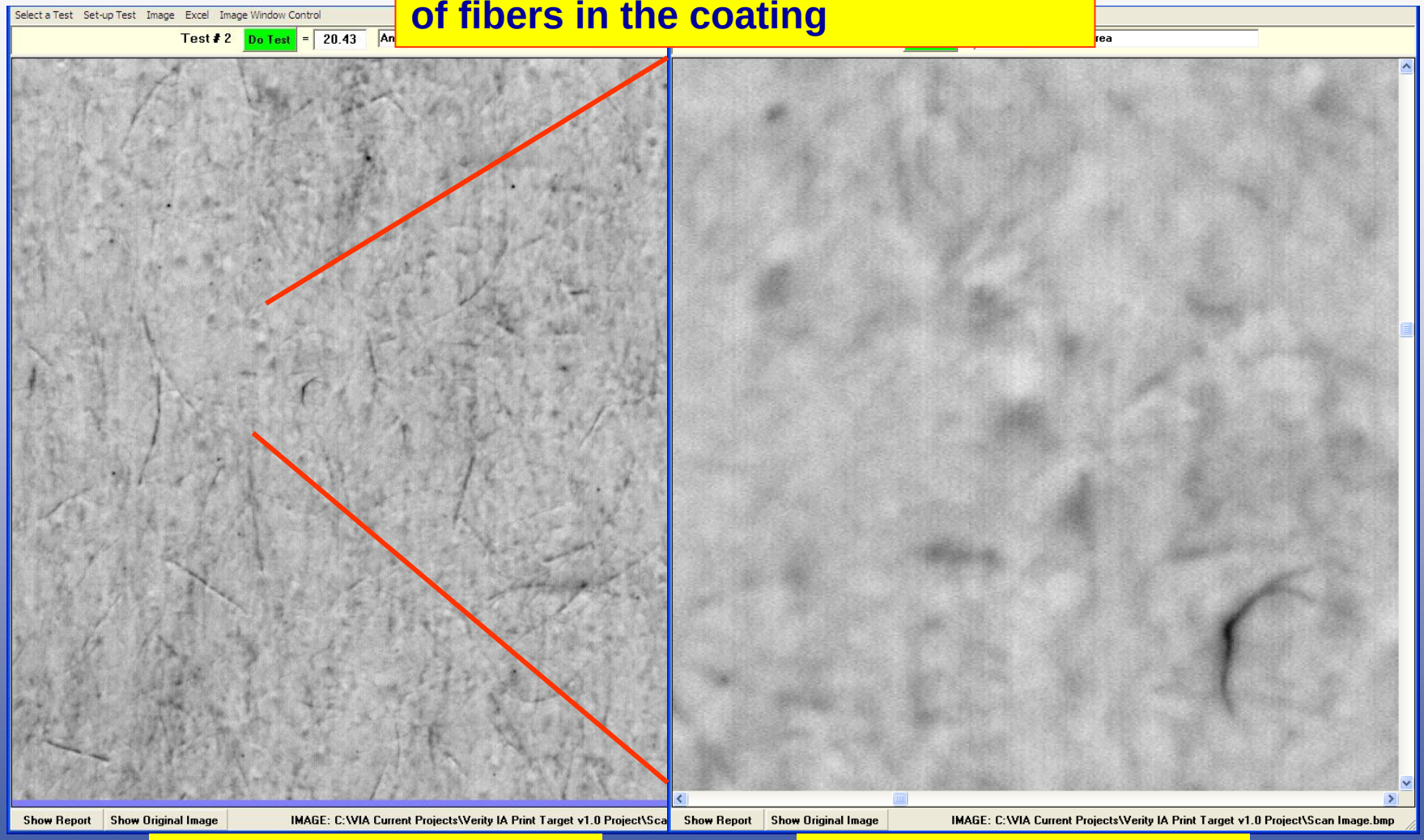
Surface Flaw – Scratch, blade or rod mark, gloss variation



Variations in smoothness, optical reflectivity (Surface Fibers), and topography contribute to printability as measured by Print Mottle.

High Resolution Magnifications of Surface Topography

These are pits with the impressions of fibers in the coating



Before zooming

After zooming

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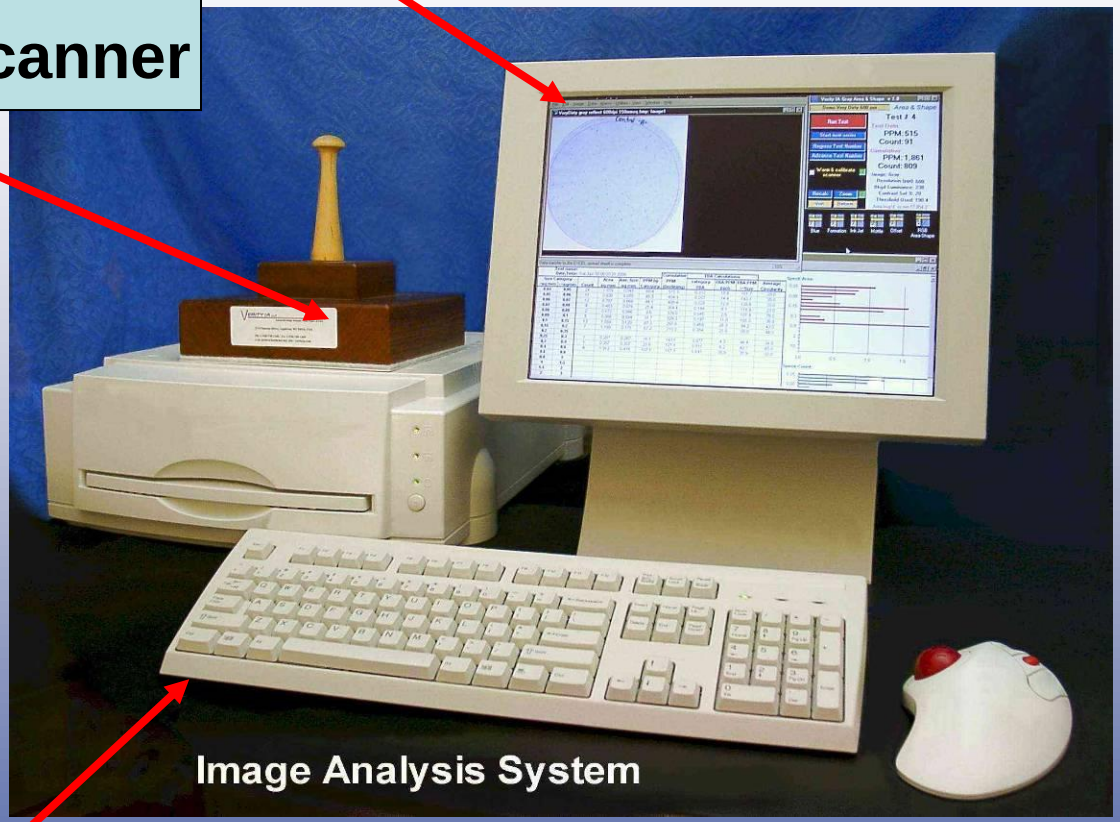
The Measurement System

Verity IA Topography & Mottle analysis software

Specially Modified Scanner

Graphic Arts Quality Scanner for Surface Topography & White faced specimen weight



Fast computer with 512 RAM

Topography

- Images the overall 3-D surface uniformity by optical means.
- Performs Selective Color Extraction prior to Measurement of Topography and Print Mottle
- Measures the 3-D non-uniformity using the Verity IA Stochastic Frequency Distribution Analysis (SFDA).

Measure Topography

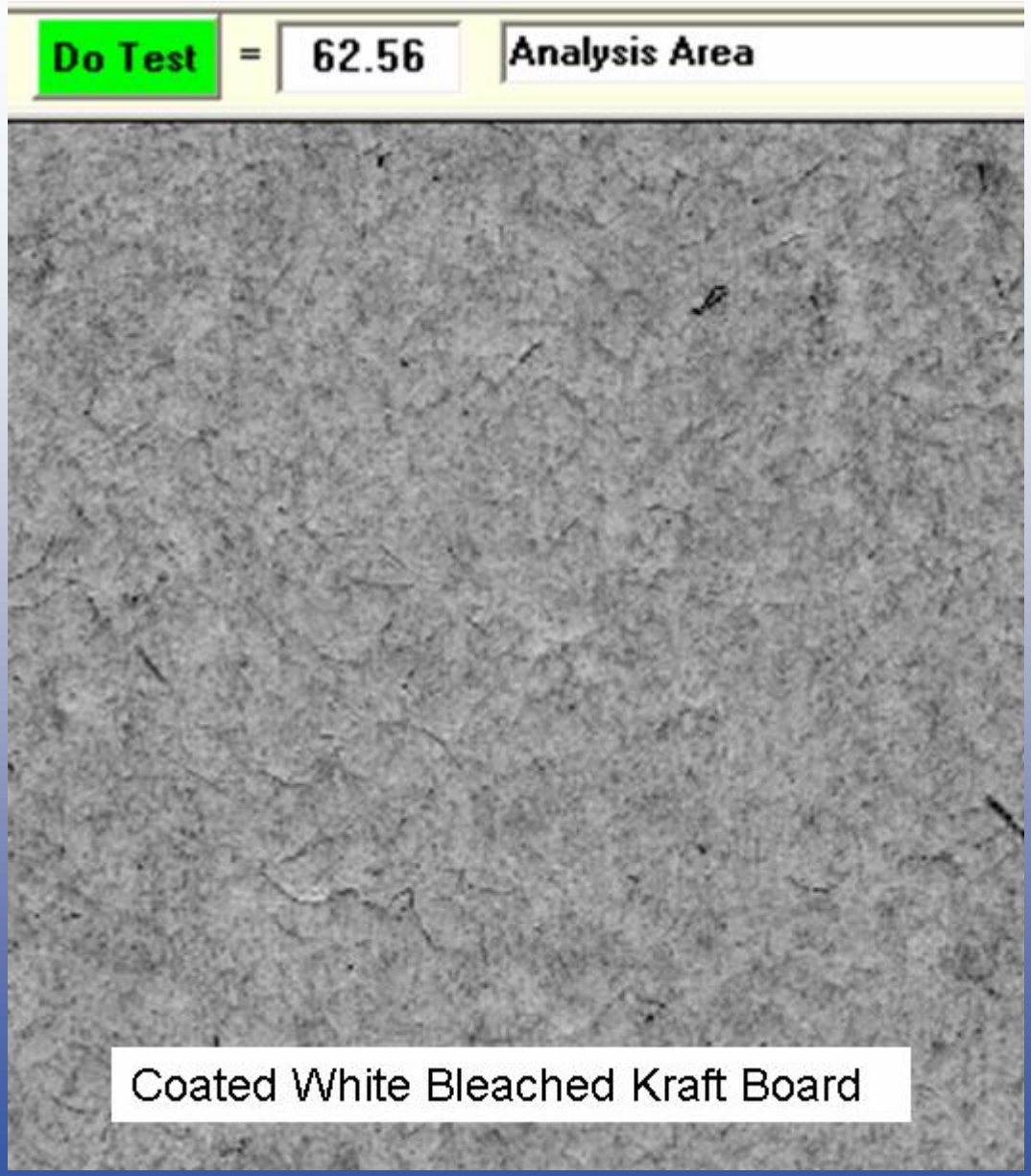
Place specimen on the topography scanner

Cover with calibrated weight

Click the “Do Test” button

Topography # 62.56

DONE!



Topography

- A zero measurement is perfection:
  - a smooth surface Topography Number = 0
- The greater the Topography Number, the greater the variations in surface texture and reflective anomalies (Surface fiber) and ultimately the greater the print mottle.
- Scan a large area:

  > 15 cm x 15 cm (4 in x 4 in)

  A large area yields a number more representative of the overall surface printing and optical performance.

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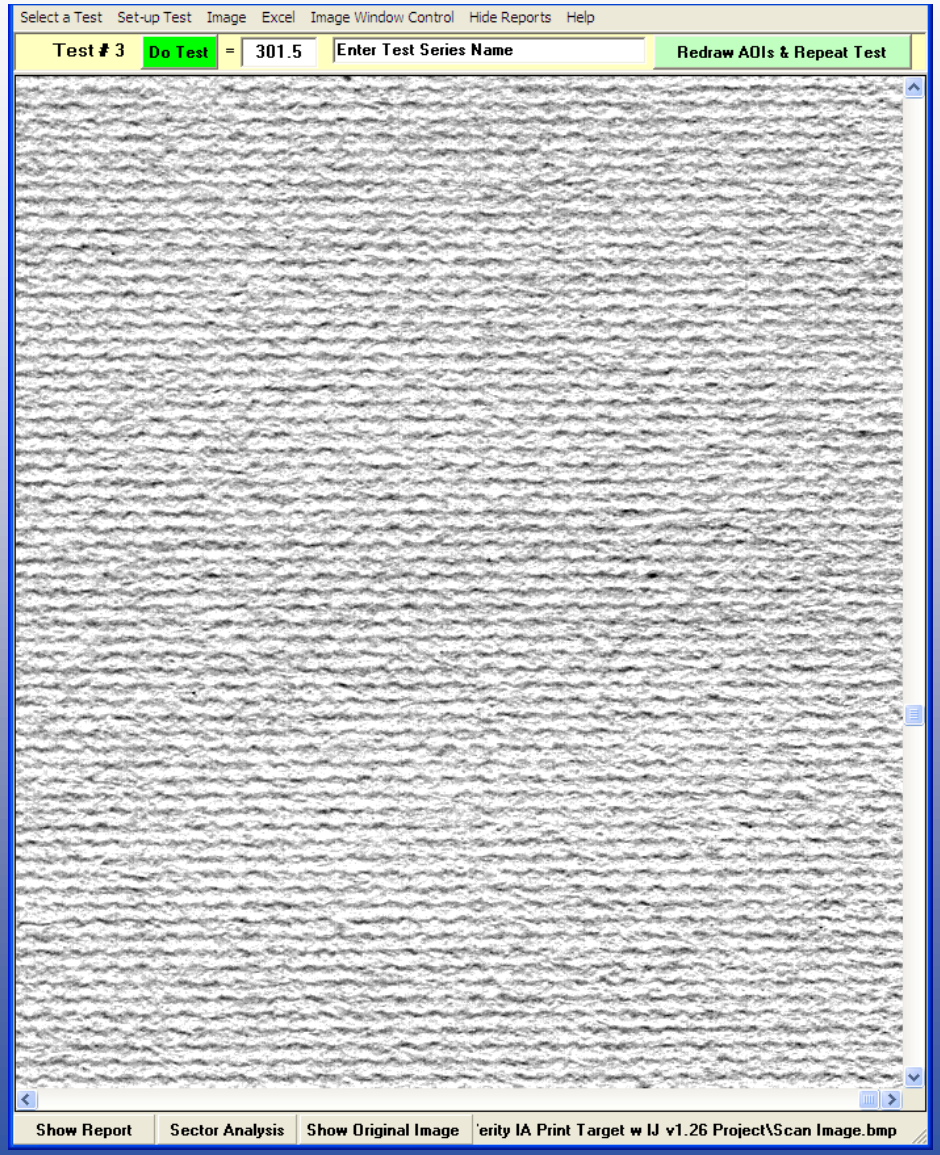
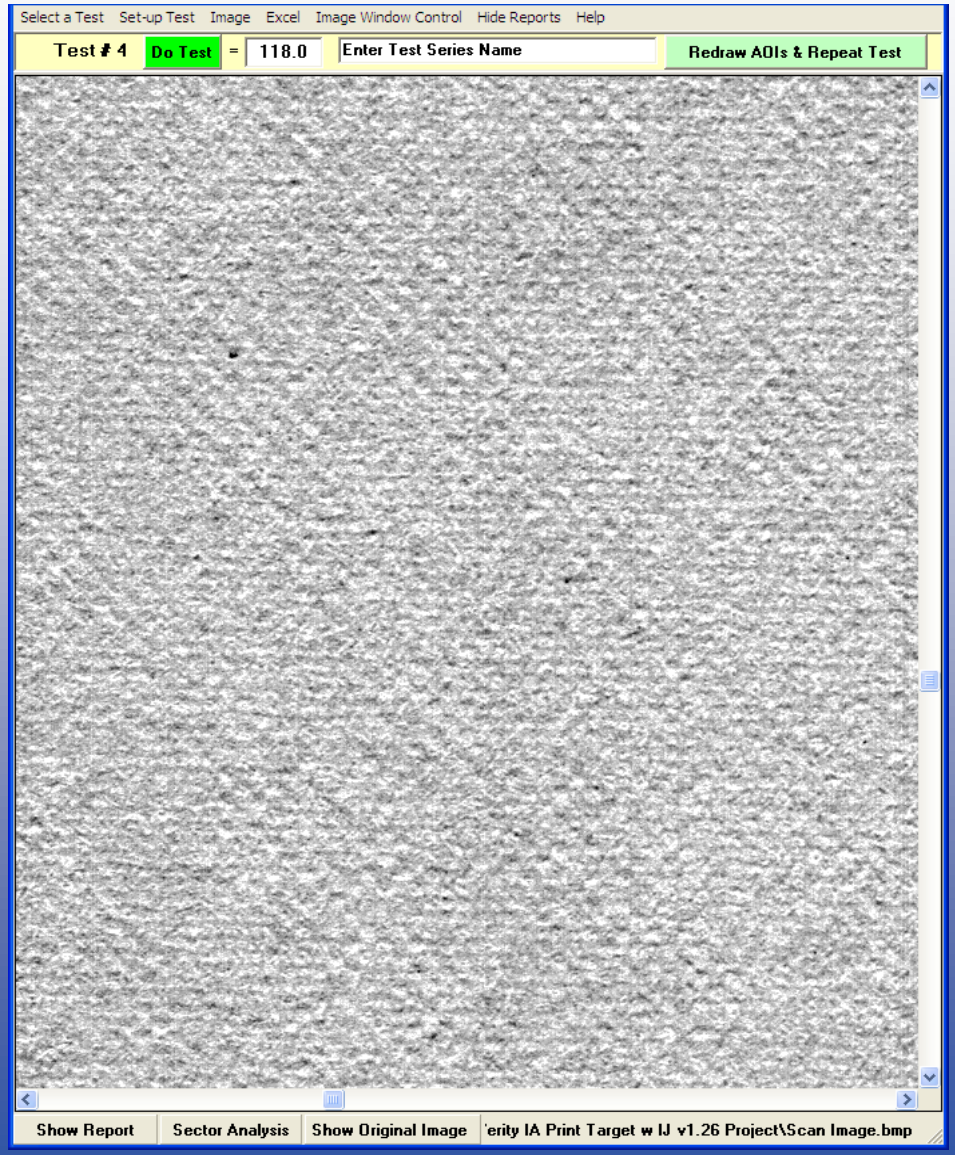
Directional Component - Laid Embossing

Machine Direction (MD)



Cross Direction (CD)



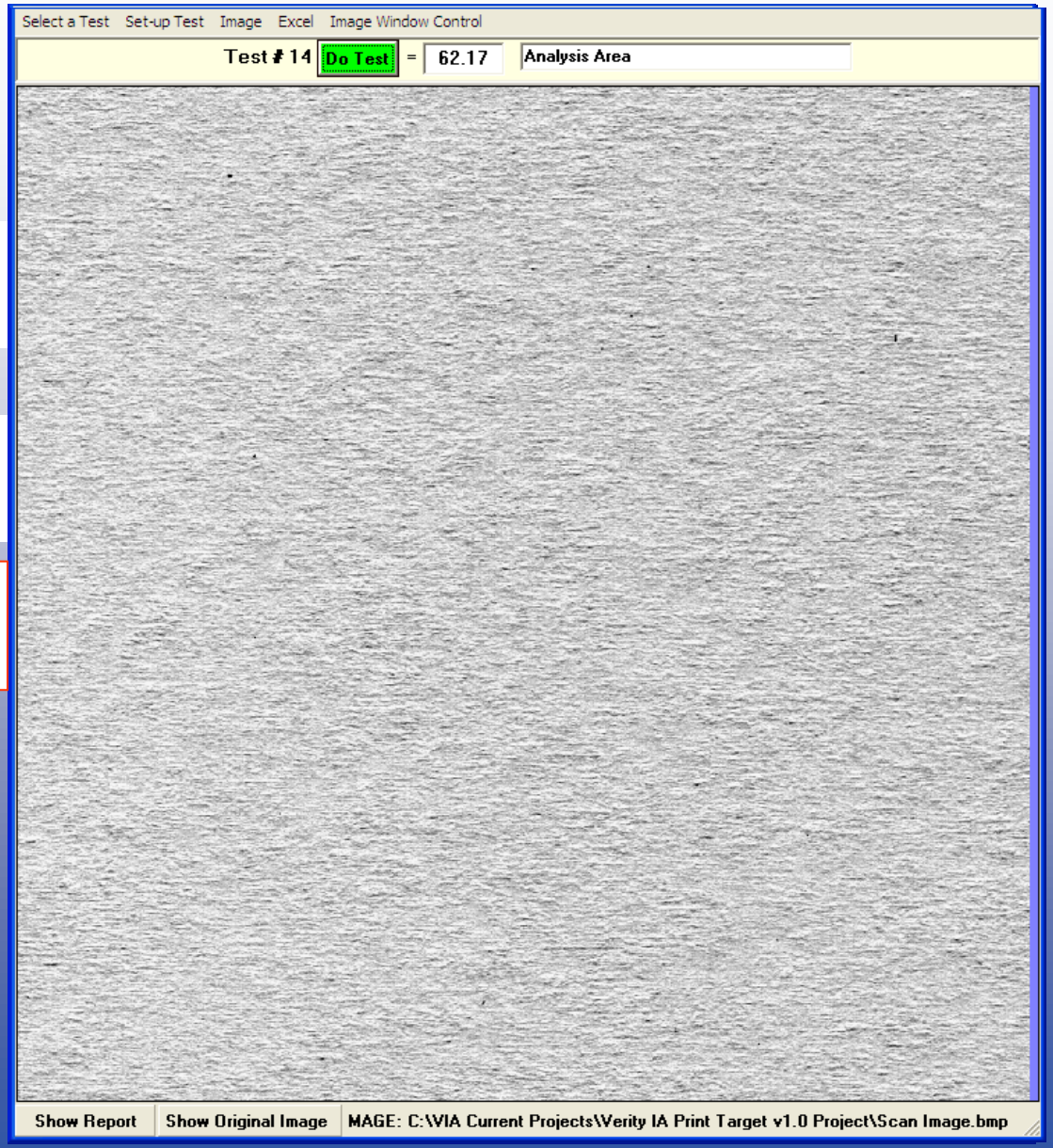
Ordinary Copy Paper

Front, MD, Topo # 51

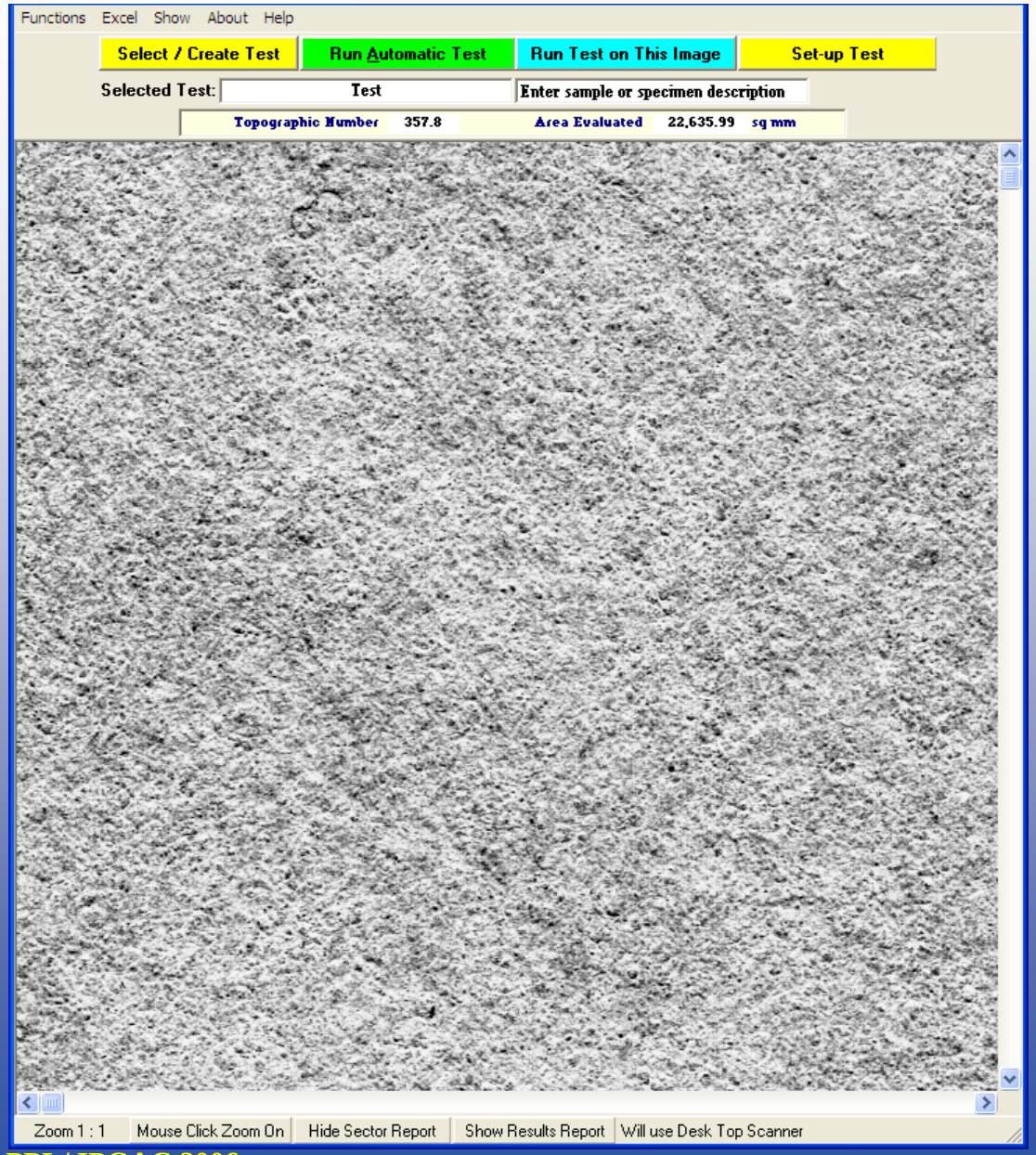
Front, CD, Topo # 52

Back, MD, Topo # 42

Back, CD Topo # 62



Light Weight Coated Base Sheet Before Coating

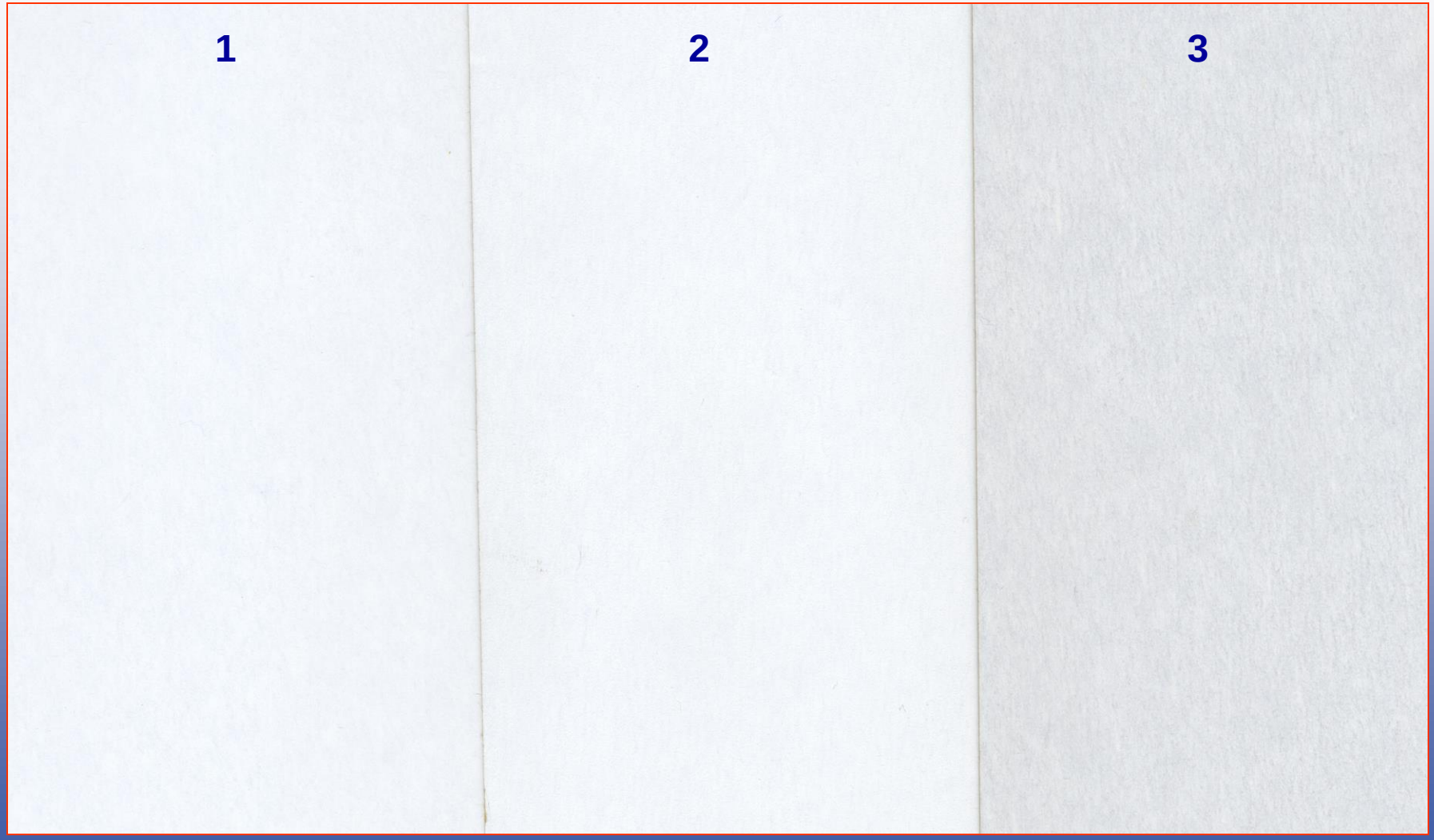


Standard topography image (zoomed) visually shows the sheet surface.

Top Coat Mottle

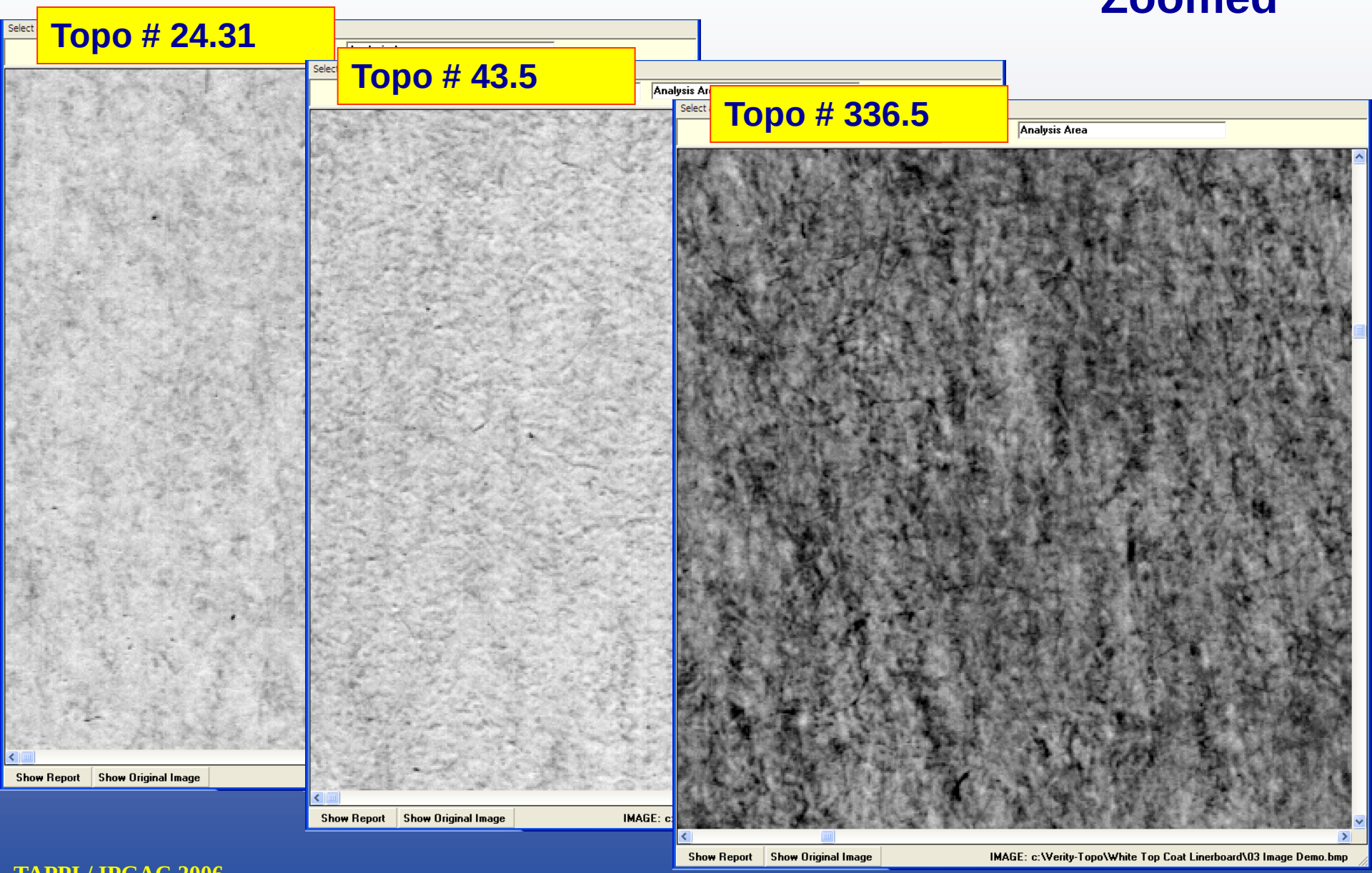
Top White Linerboard : Three Trials

Visual Appearance



White Linerboard : Three Trials

Zoomed

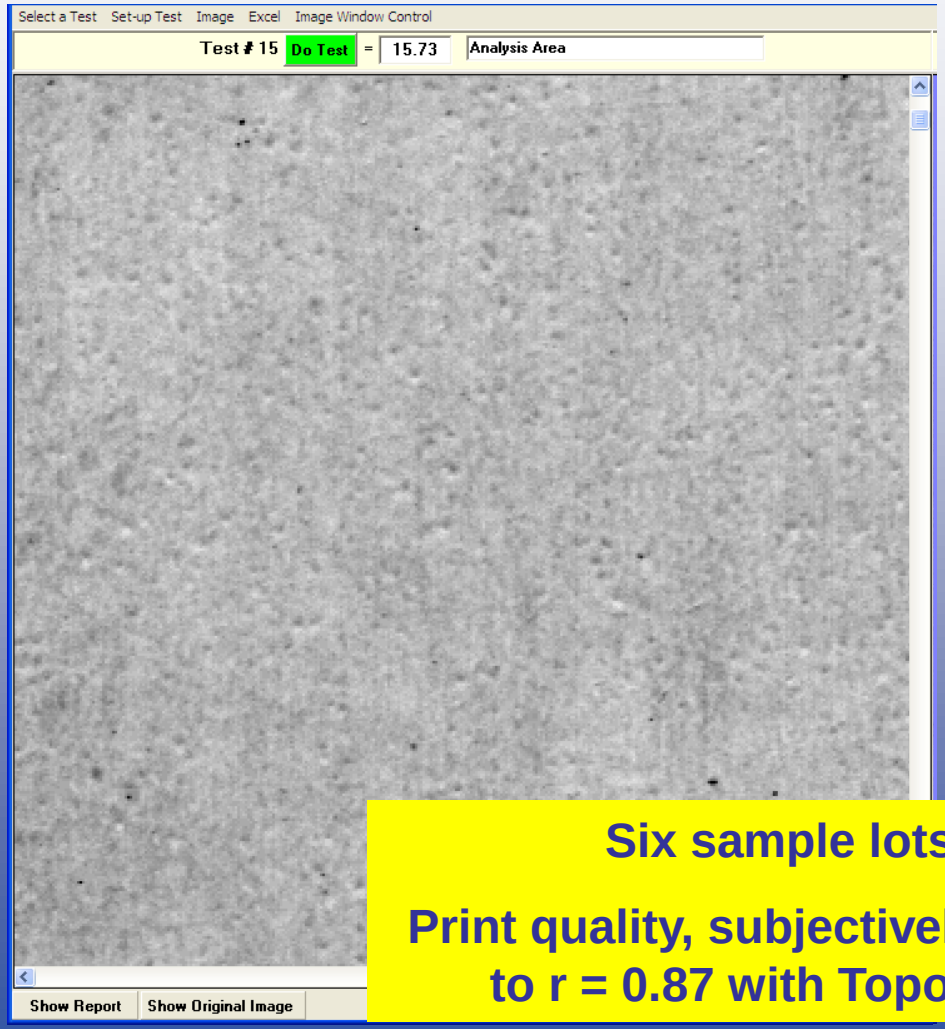


Coated Board

Coated Board, White Bleached Kraft

Good

Topo # 15.73



Bad

Topo # 98.89

Six sample lots evaluated.

Print quality, subjectively ranked, correlated to r = 0.87 with Topo measurements.

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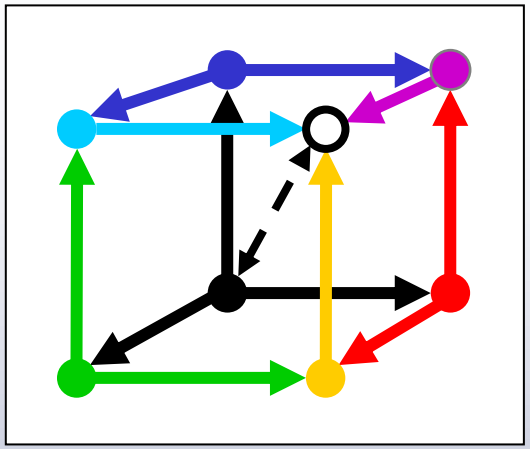
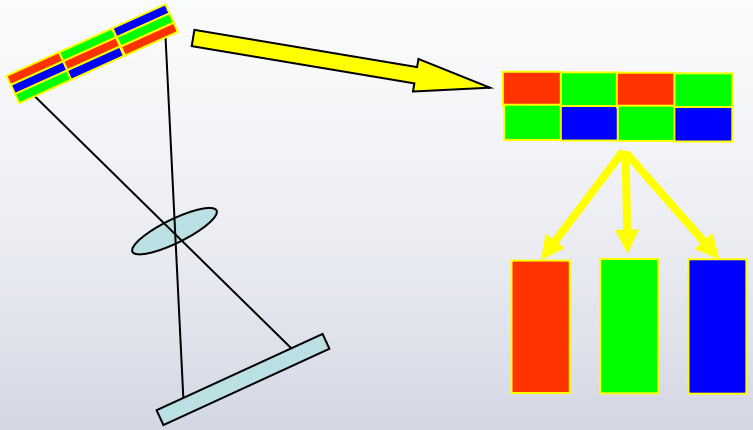
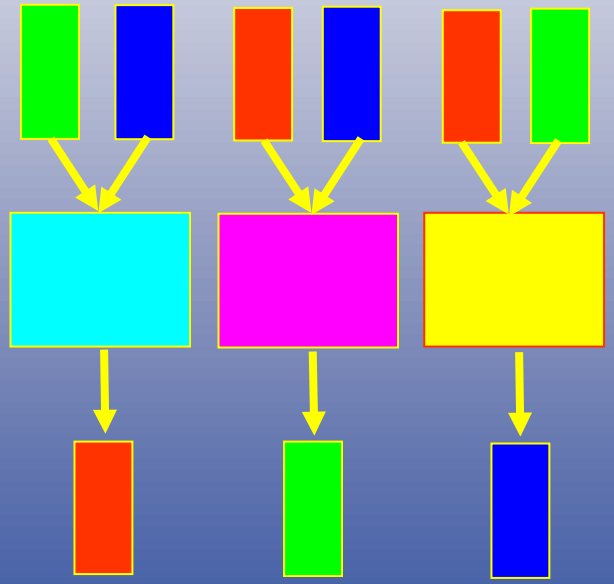
Color Extraction



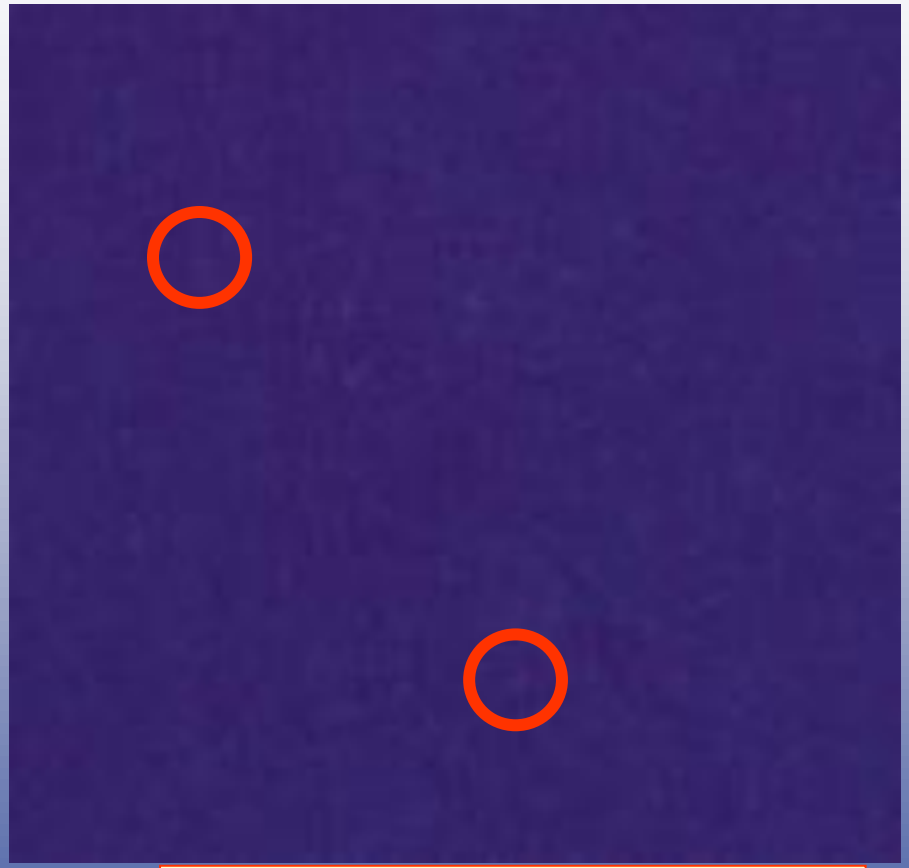


- Camera and Scanner CCD array of sensors produce an RGB image.
- Individually examine the effects of Cyan, Magenta, and Yellow Ink as:
  - Reflected Components
  - Absorbed Components



Color Extraction

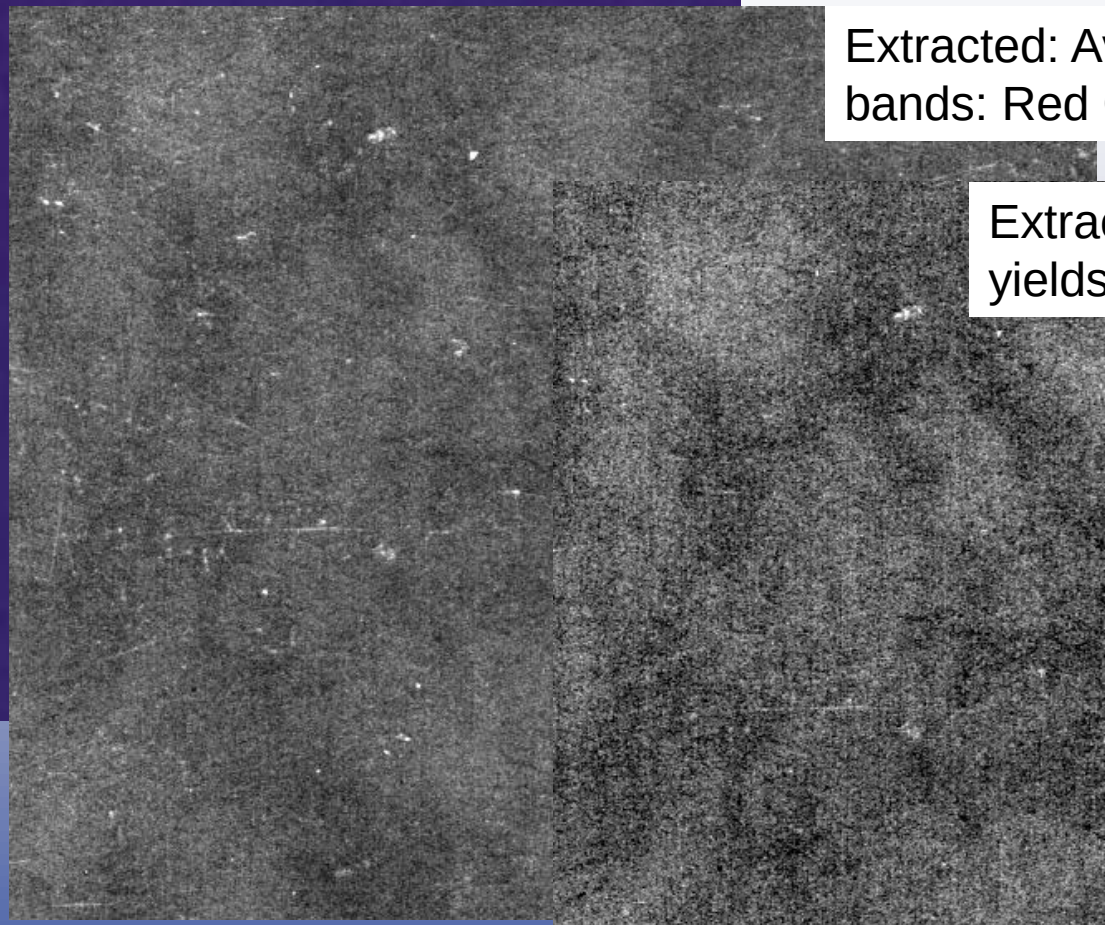
Mottle Measurement - CMY Extraction – A Motley Blue



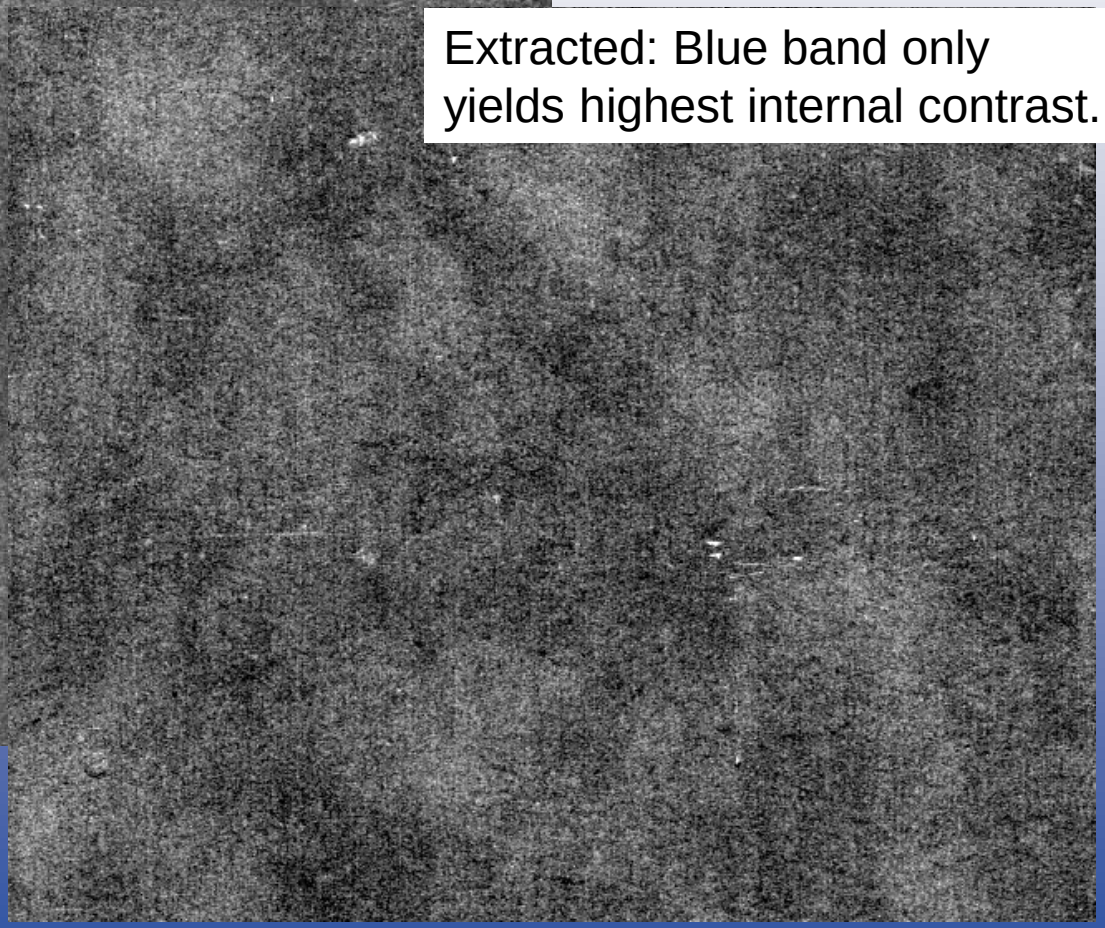
Solid Blue, Cyan + Magenta inks
Demonstrating a subtle two color mottle.

Color Extraction – Better Internal Contrast

Original - Royal Blue Printed Cyan and Magenta inks. Scanned full color.

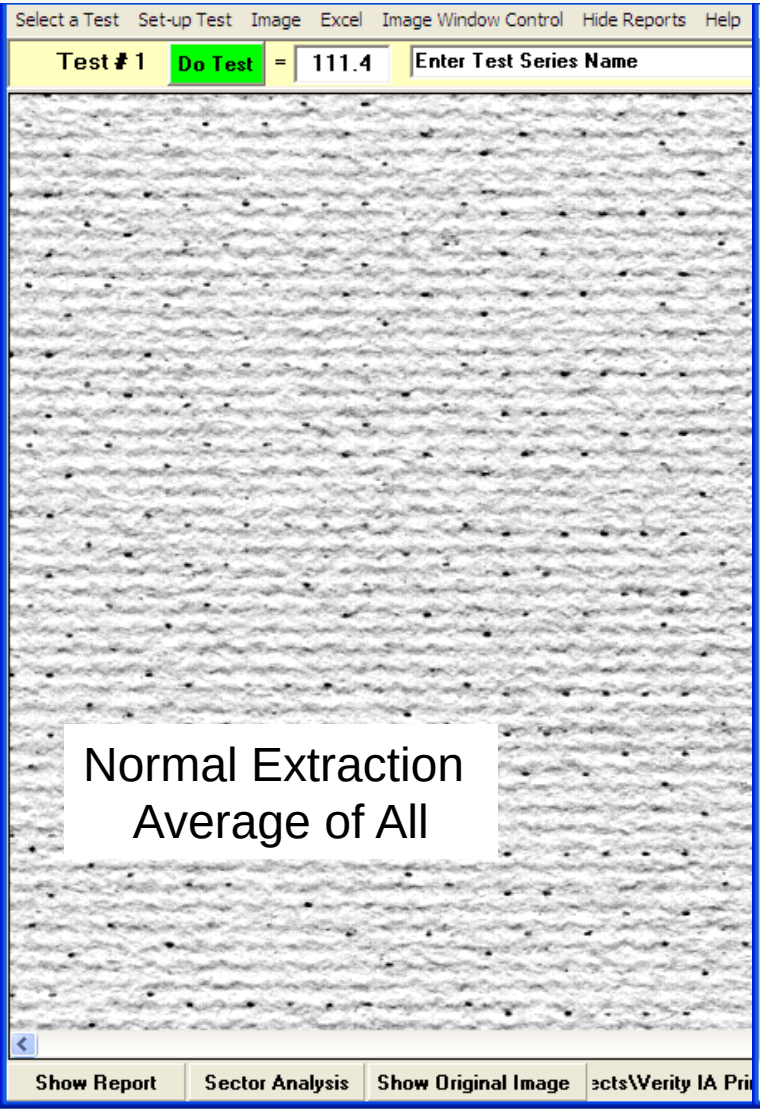


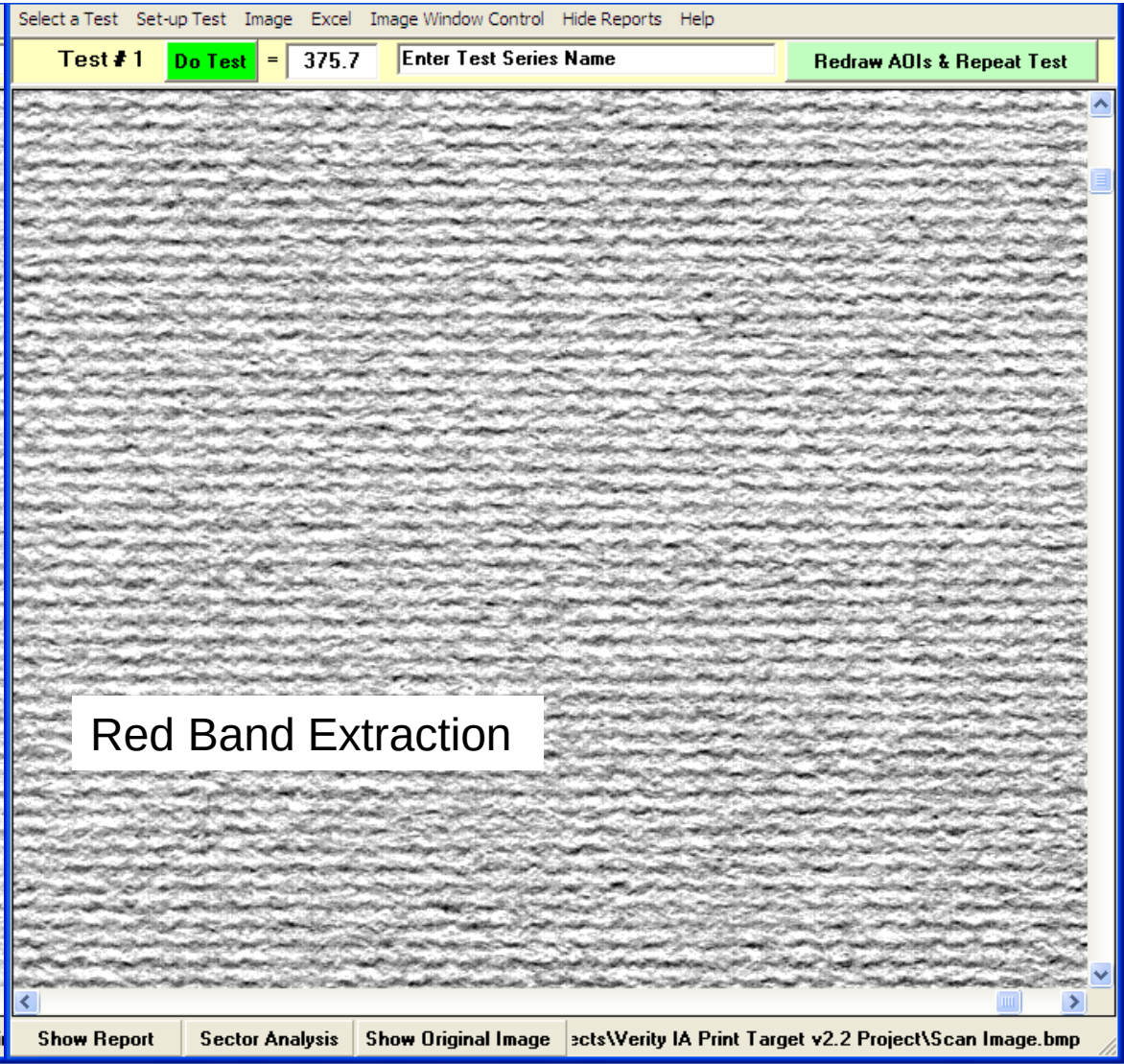
Extracted: Average of All bands: Red Green & Blue



Extracted: Blue band only yields highest internal contrast.

Color Extraction – Effect of UV Brighteners





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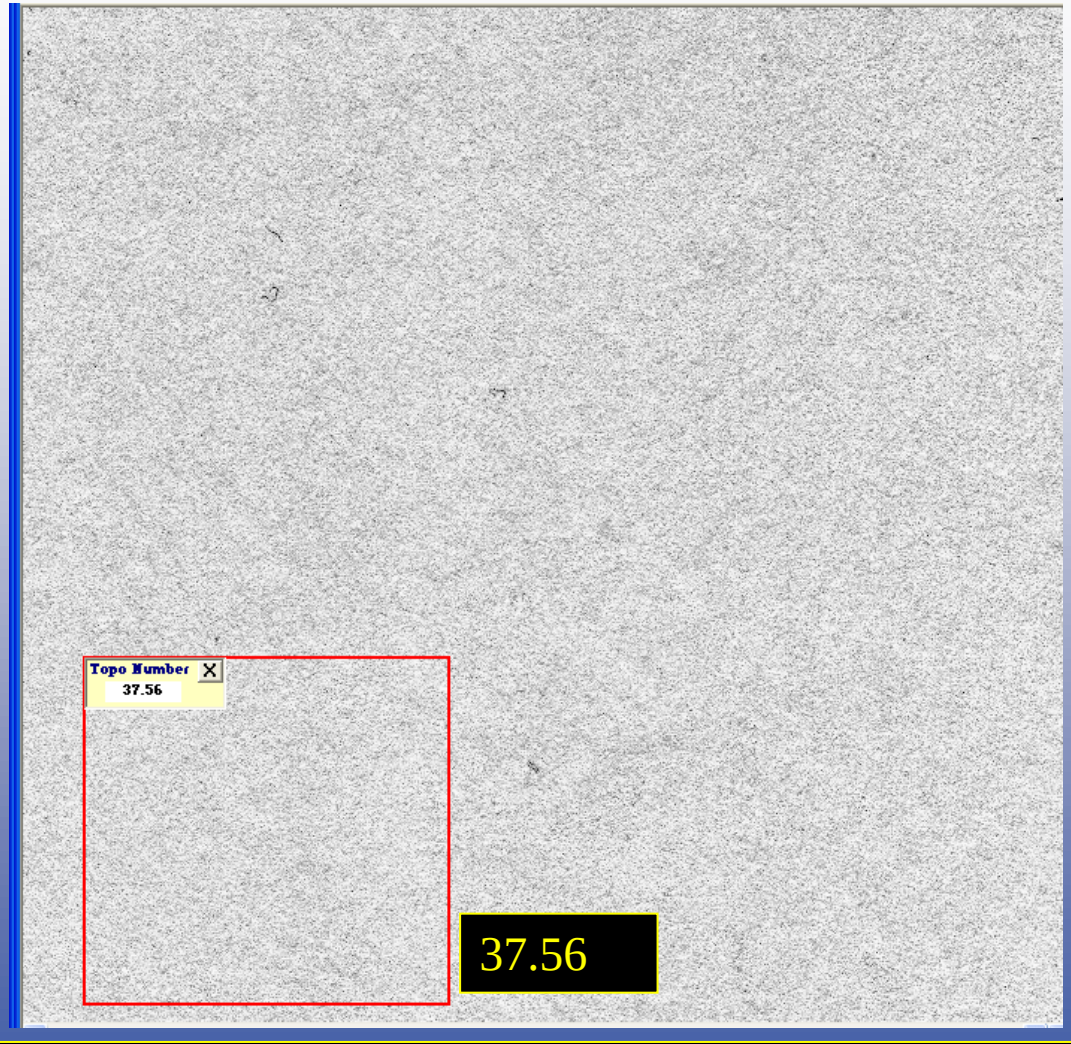
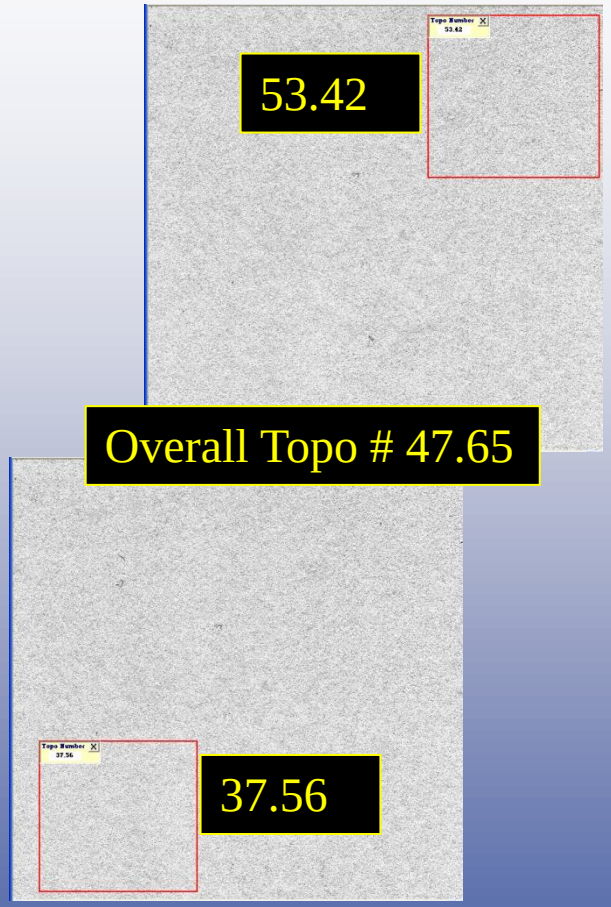
The Topo measurement in different areas of same base sheet



Total Area: 15 cm X 15 cm Overall Result: Verity Topo #47.65

The measurement in different areas of same sheet



The topography measurement system overcomes the problem of area to area variations by measuring within a large area. In the LWC series run at RIT the measurements in the coated sheet tests were made overall of an imaged area, 15 cm X 15 cm, both, in the machine (MD) & cross (CD) directions. The MD & CD measurements (10) were then averaged for the correlation to print mottle (Pattern Measurement).

The small sectional variations illustrated in this example are also present in every sheet tested and cover roughly the same area as a conventional surface smoothness tester would cover.

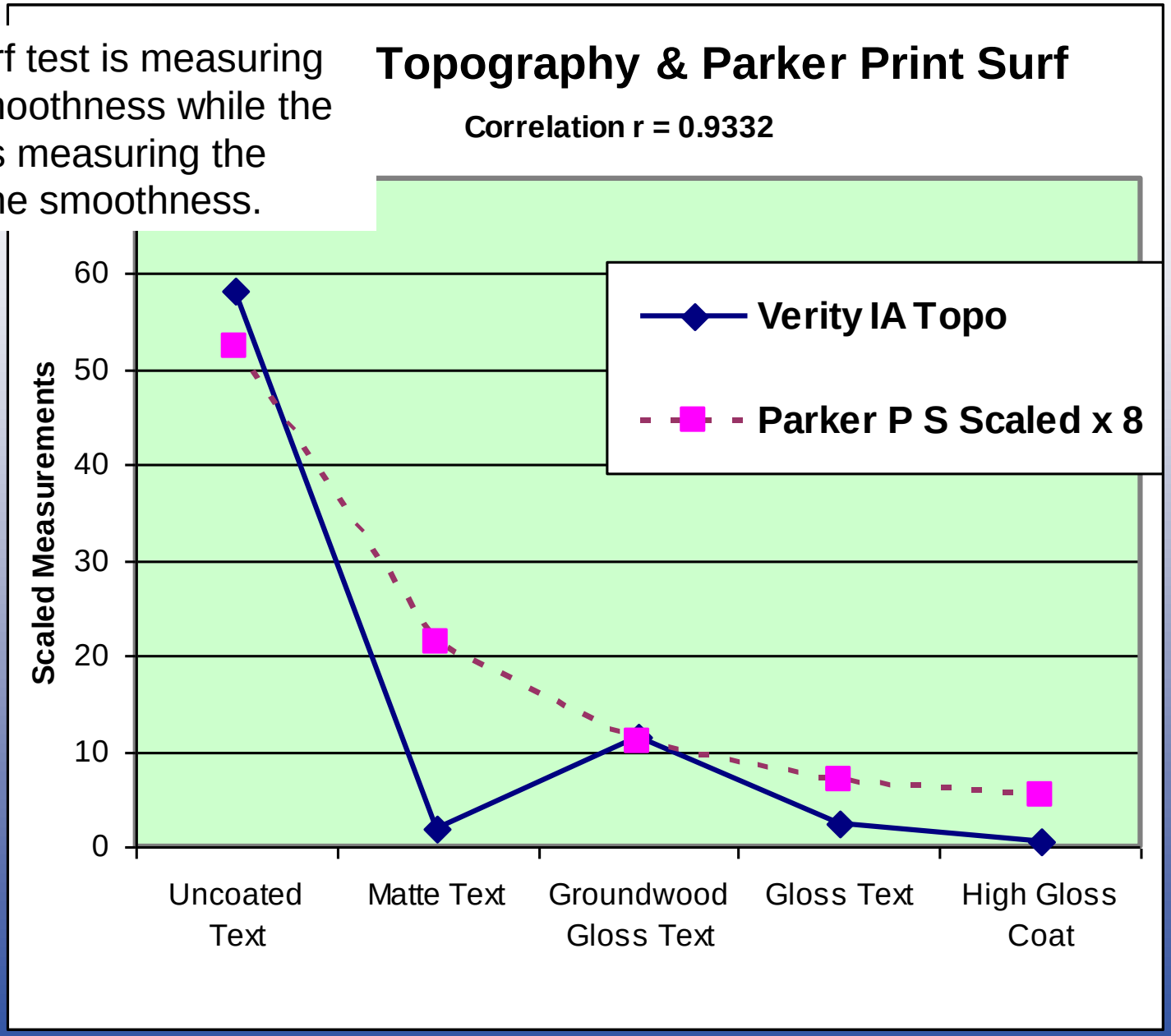
Total Area: 15 cm X 15 cm Result: Verity Topo #47.65

Correlation: Verity IA Topography to Parker Print Surf

Verity IA Topography			Parker Print Surf	
MD	Uncoated text	42.87	Uncoated Text	6.45
CD	Uncoated text	62.00	Uncoated Text	6.94
MD	Uncoated text	48.51	Uncoated Text	6.36
CD	Uncoated text	75.45	Uncoated Text	6.56
MD	Uncoated text	44.46	Uncoated Text	6.47
CD	Uncoated text	76.54		
	Average	58.31	Average	6.56
MD	Matte Text	1.45	Matte Text	2.63
CD	Matte Text	1.87	Matte Text	2.48
MD	Matte Text	1.42	Matte Text	2.55
CD	Matte Text	1.93	Matte Text	3.05
MD	Matte Text	1.62	Matte Text	2.69
CD	Matte Text	2.17		
	Average	1.74	Average	2.68
MD	Groundwood Gloss Text	12.74	Groundwood Gloss Text	1.44
CD	Groundwood Gloss Text	11.29	Groundwood Gloss Text	1.36
MD	Groundwood Gloss Text	10.83	Groundwood Gloss Text	1.29
CD	Groundwood Gloss Text	11.09	Groundwood Gloss Text	1.35
MD	Groundwood Gloss Text	11.74	Groundwood Gloss Text	1.37
CD	Groundwood Gloss Text	10.80		
	Average	11.42	Average	1.36
MD	Gloss Text	2.30	Gloss Text	0.85
CD	Gloss Text	2.22	Gloss Text	0.85
MD	Gloss Text	2.48	Gloss Text	0.84
CD	Gloss Text	2.62	Gloss Text	0.83
MD	Gloss Text	2.65	Gloss Text	0.9
CD	Gloss Text	2.45		
	Average	2.45	Average	0.85
MD	Kromekote	0.42	Kromekote	0.68
CD	Kromekote	0.41	Kromekote	0.67
MD	Kromekote	0.44	Kromekote	0.65
CD	Kromekote	0.46	Kromekote	0.73
MD	Kromekote	0.41	Kromekote	0.66
CD	Kromekote	0.42		
	Average	0.43	Average	0.68

Correlation: Verity IA Topography to Parker Print Surf

The Print - Surf test is measuring the surface smoothness while the Verity - Topo is measuring the uniformity of the smoothness.



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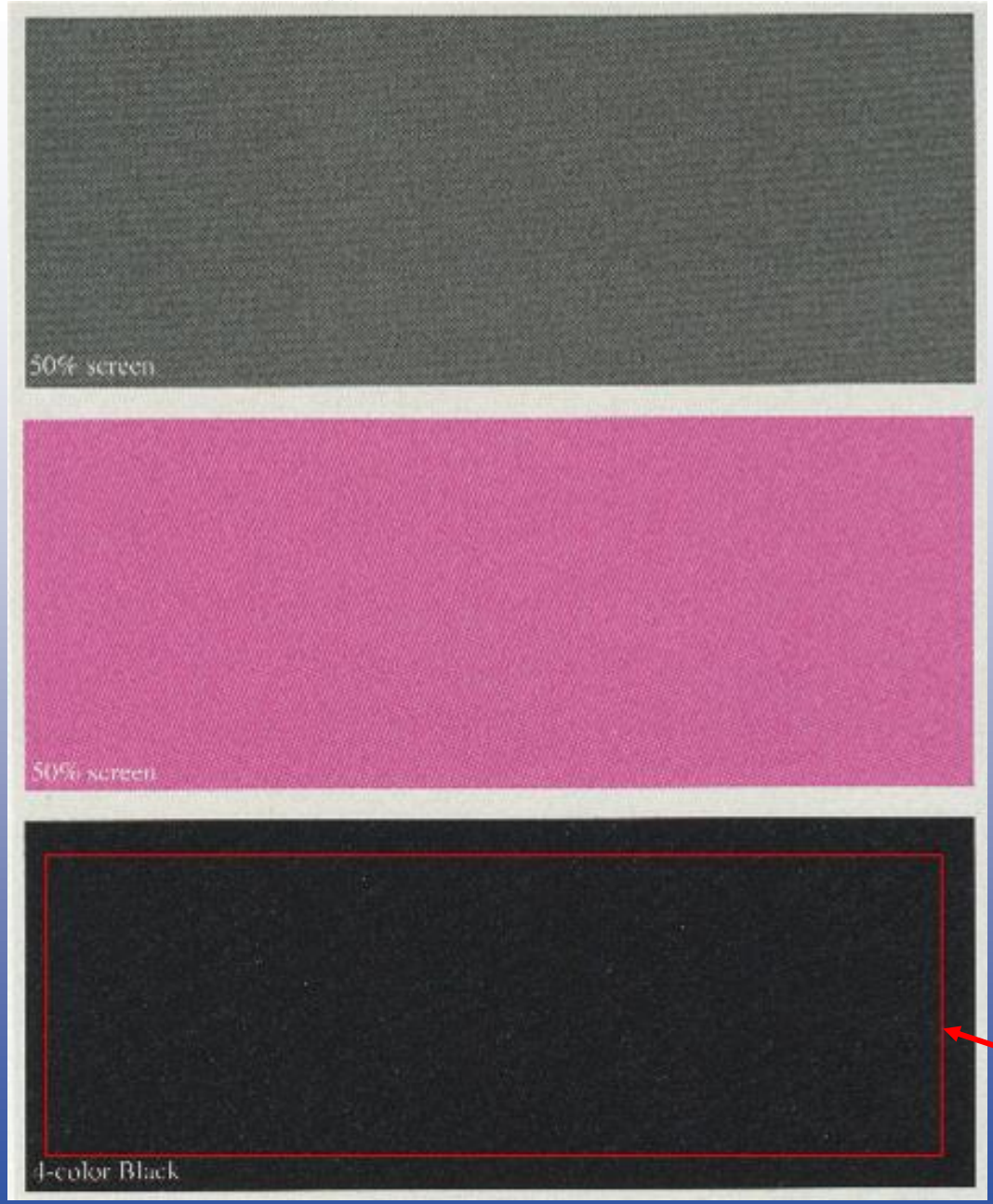
Test LWC to Print Mottle

- Unprinted slabs were removed, pre-press, marked and identified from several rolls of LWC, with five (5) undisclosed variations in:
  - Coating formulation,
  - Coating application techniques,
  - Base sheet
- Pre-press:
  - Specimens of each LWC set were tested on Verity IA Topography analysis system.
- Post- press:
  - Printed areas of four color (4) Black,
  - 50% Tint Black,
  - Tested with Verity IA Print Mottle
- Results of unprinted topography correlated to print mottle measurements

The Printed Pattern – LWC



50% Screen, Black

(Exhibits the Moiré effect in the computer display from which it was copied for this presentation.)

Each printed rectangle is:

57 mm x 148 mm

50% Screen, Magenta

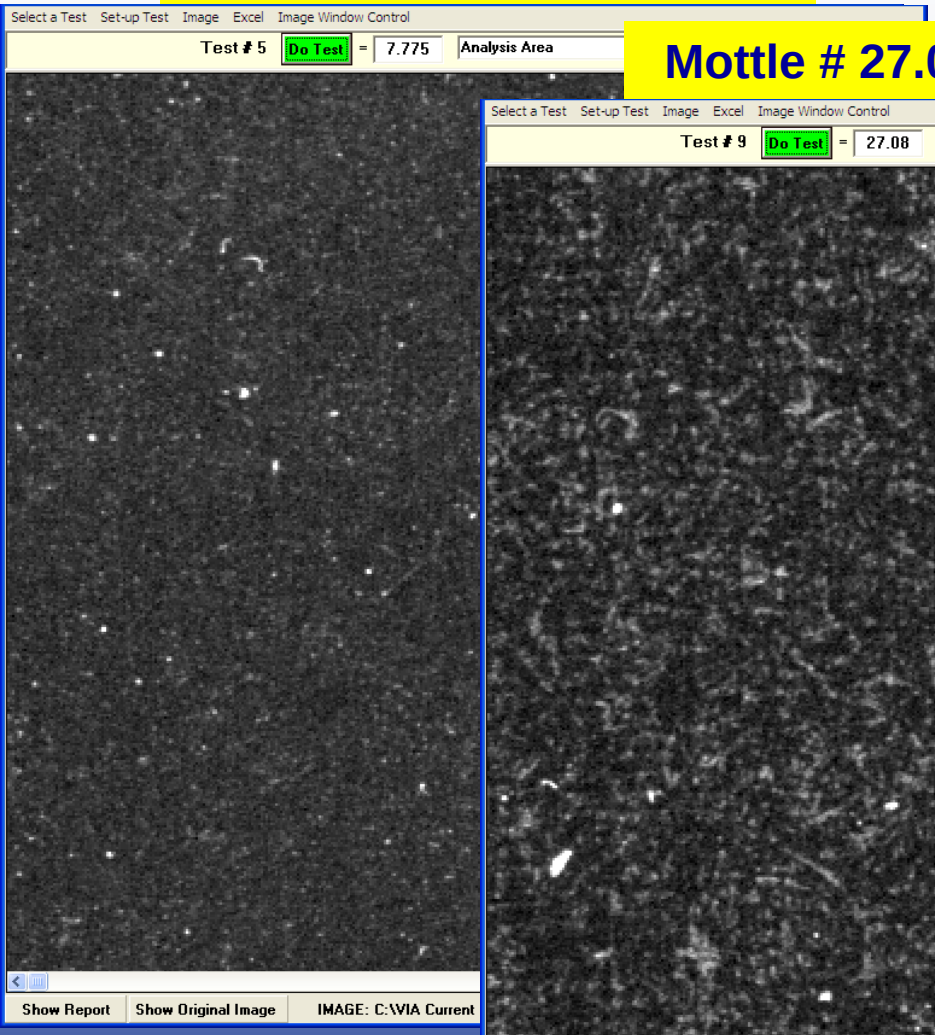
4 color black

The software draws this rectangle to enclose area of measurement

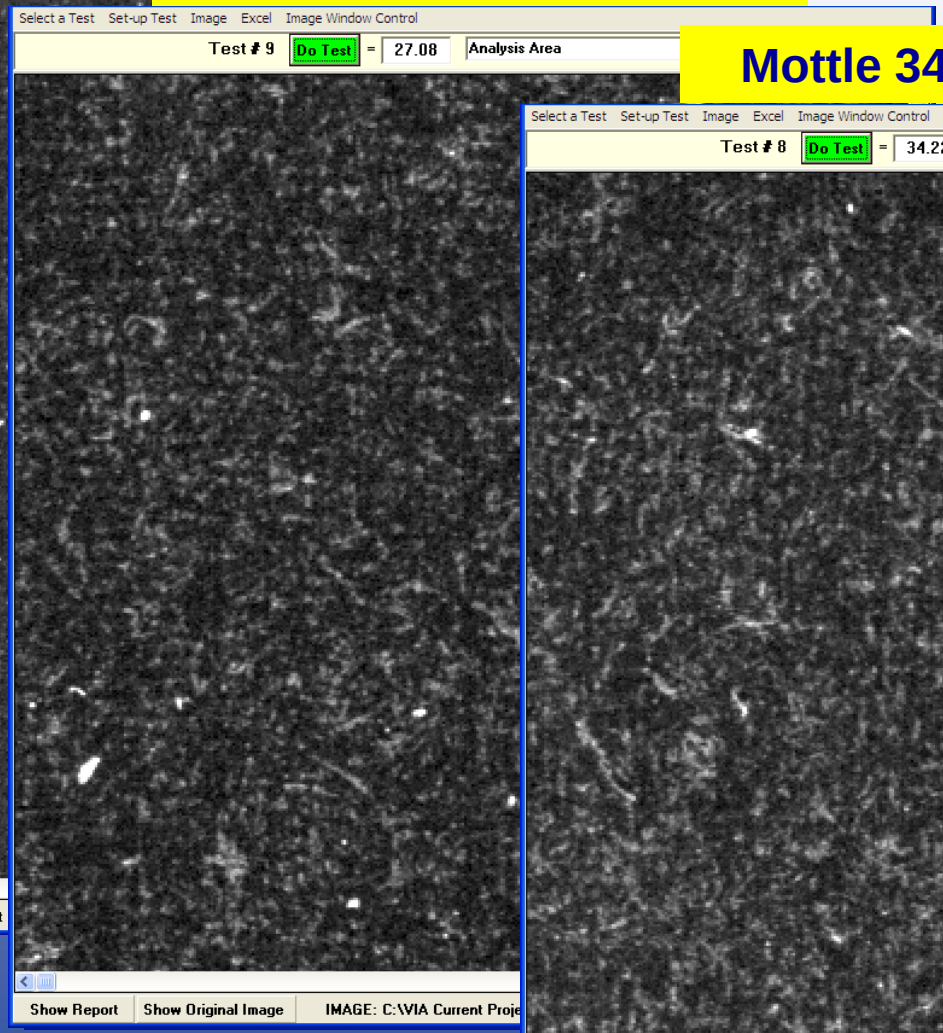
Light Weight Coated (LWC)

Print Mottle - Four Color Black

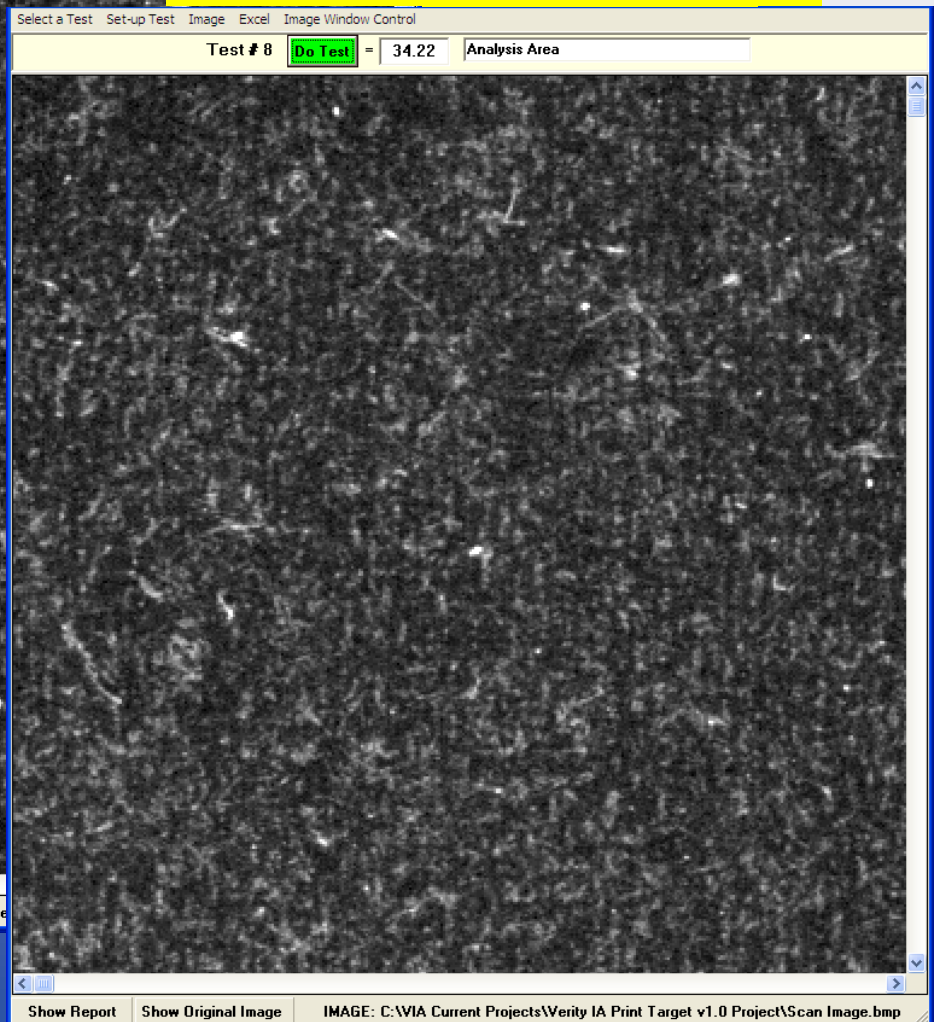
Mottle # 7.9 Topo # 14.1



Mottle # 27.0 Topo # 33.0



Mottle 34.2 Topo # 54.1



The Correlation of Coated Paper Optical Surface Topography to Print Mottle

Top Mottle Index — Averages — **…face Topography**

4 Color Black — Top

				Average	Stdev	Average	Stdev
1	6.2	6.7	6.1	6.3	0.363	11.6	2.046
2	4.3	3.7	3.9	4.0	0.271	16.1	0.687
3	5.1	5.1	4.8	5.0	0.178	12.9	0.895
4	49.4	48.8	50.5	49.6	0.871	33.0	1.970
3	5.0	5.6	3.9	4.8	0.890	12.9	0.895
4	25.5	30.5	30.3	28.8	2.839	33.0	1.970
7	46.6	42.9	49.4	46.3	2.244	52.1	1.662

Correlation: 0.91

Bottom Mottle In… — Averages — **…face Topography**

4 Color Black — Bottom

				Average	Stdev	Average	Stdev
1	8.3	7.8	7.6	7.9	0.349	9.7	1.335
2	12.0	12.8	10.5	11.7	1.170	20.4	1.868
3	8.8	9.1	7.6	8.5	0.757	11.5	0.641
4	55.6	56.5	56.4	56.2	0.524	32.3	1.000
3	7.9	7.4	9.0	8.1	0.839	11.5	0.641
4	46.5	48.8	45.7	47.0	1.582	32.3	1.000
7	52.8	55.2	52.3	53.5	1.554	53.3	2.185

Correlation: 0.89

Top Mottle Inde… — Averages — **…face Topography**

50 % Tint Black — Top

				Average	Stdev	Average	Stdev
1	12.3	12.4	12.9	12.5	0.302	11.6	2.046
2	13.8	13.7	13.9	13.8	0.109	16.1	0.687
3	7.8	7.6	7.5	7.6	0.163	12.9	0.895
4	34.8	34.9	32.6	34.1	1.313	33.0	1.970
3	19.6	18.7	19.6	19.3	0.535	12.9	0.895
4	63.3	65.0	68.0	65.4	2.377	33.0	1.970
7	85.9	78.1	87.7	83.9	5.126	52.1	1.662

Correlation: 0.94

Bottom Mottle In… — Averages — **…face Topography**

50 % Tint Black — Bottom

				Average	Stdev	Average	Stdev
1	7.2	7.1	6.8	7.0	0.218	9.7	1.335
2	8.8	8.6	9.4	8.9	0.419	20.4	1.868
3	5.2	5.3	5.0	5.1	0.159	11.5	0.641
4	13.9	13.4	13.1	13.4	0.416	32.3	1.000
3	7.6	7.3	7.6	7.5	0.181	11.5	0.641
4	13.8	14.1	15.0	14.3	0.621	32.3	1.000
7	28.1	30.1	31.2	29.8	1.581	53.3	2.185

Correlation: 0.96

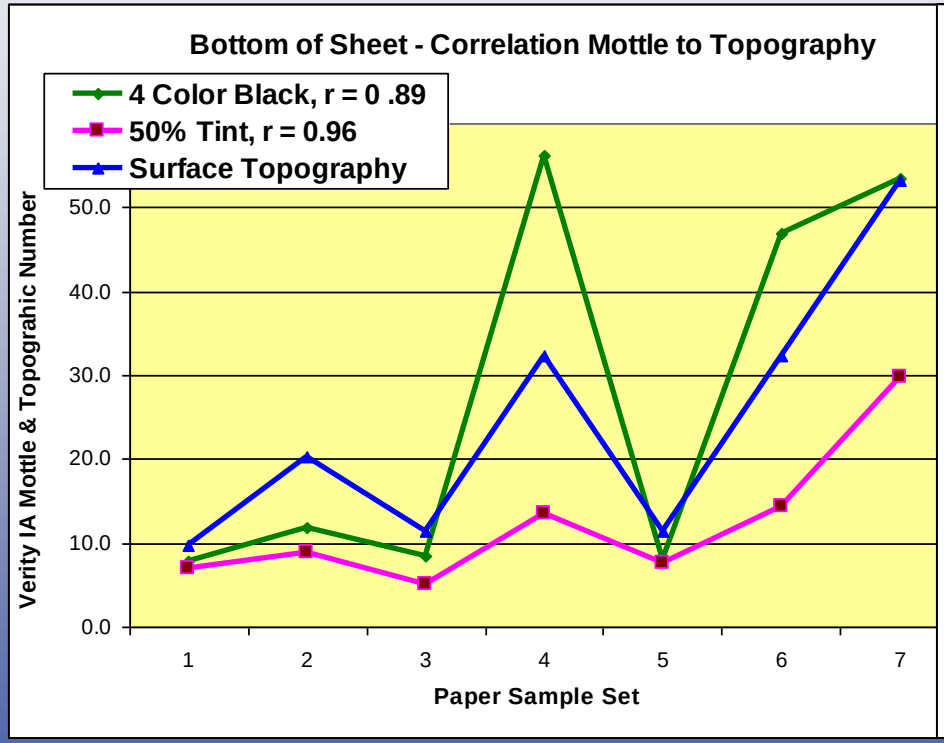
Printing Trials were run twice on coated sheets #3 & #4. Thus there are double entries to indicate the same coated sheet was used in two different press runs. Note the different mottle readings.

The Optical Topography Measurement of the Coated Surface will Predict Print Mottle on LWC

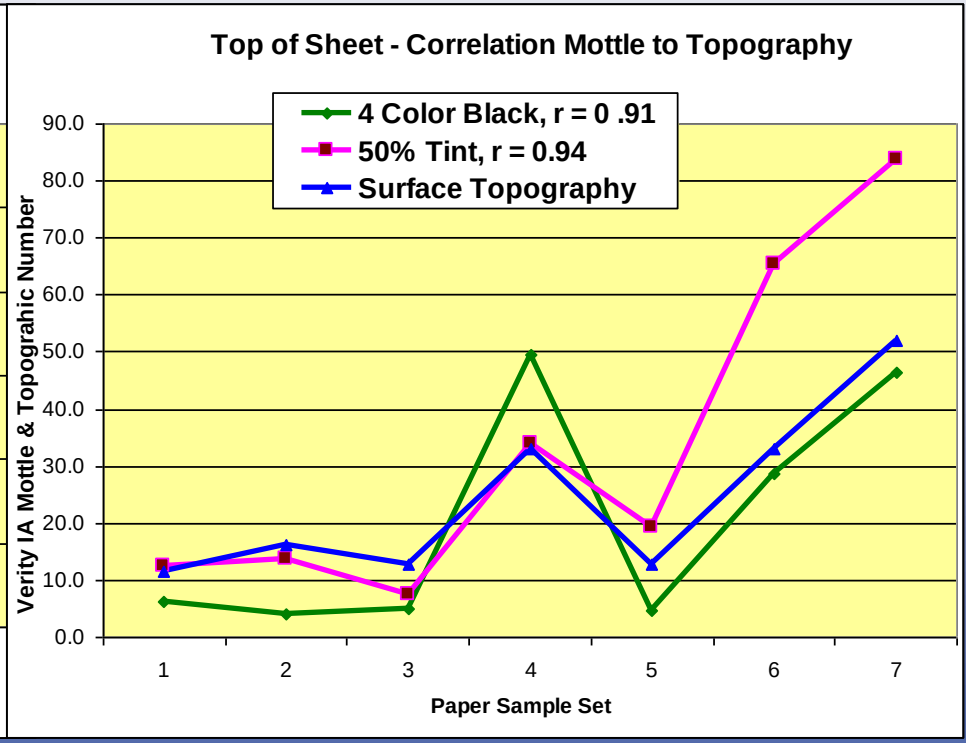
LWC Print Mottle to Topography

Topography Measurement

will Predict Offset Print Mottle on LWC



Bottom

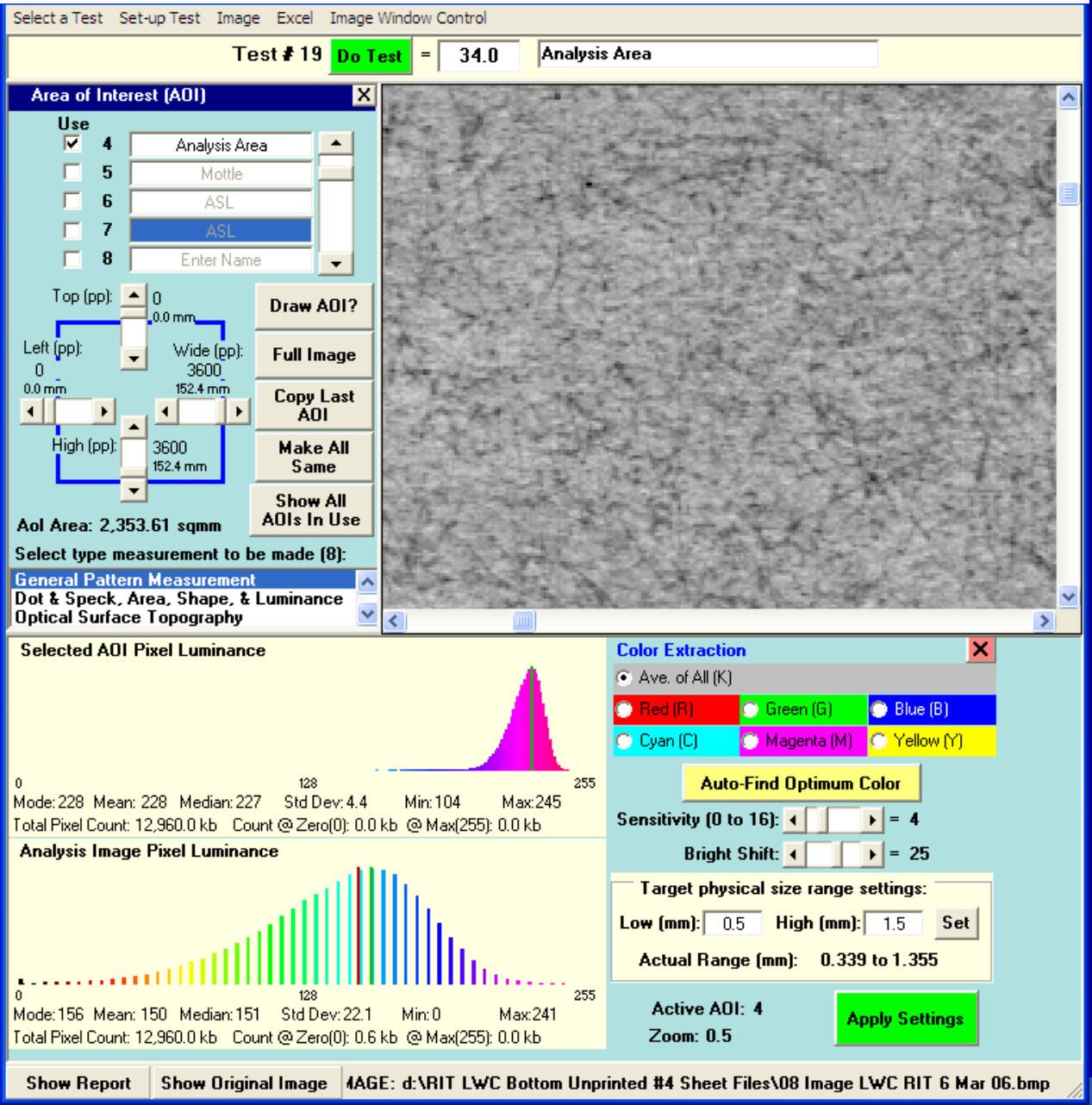


Top

Thank You

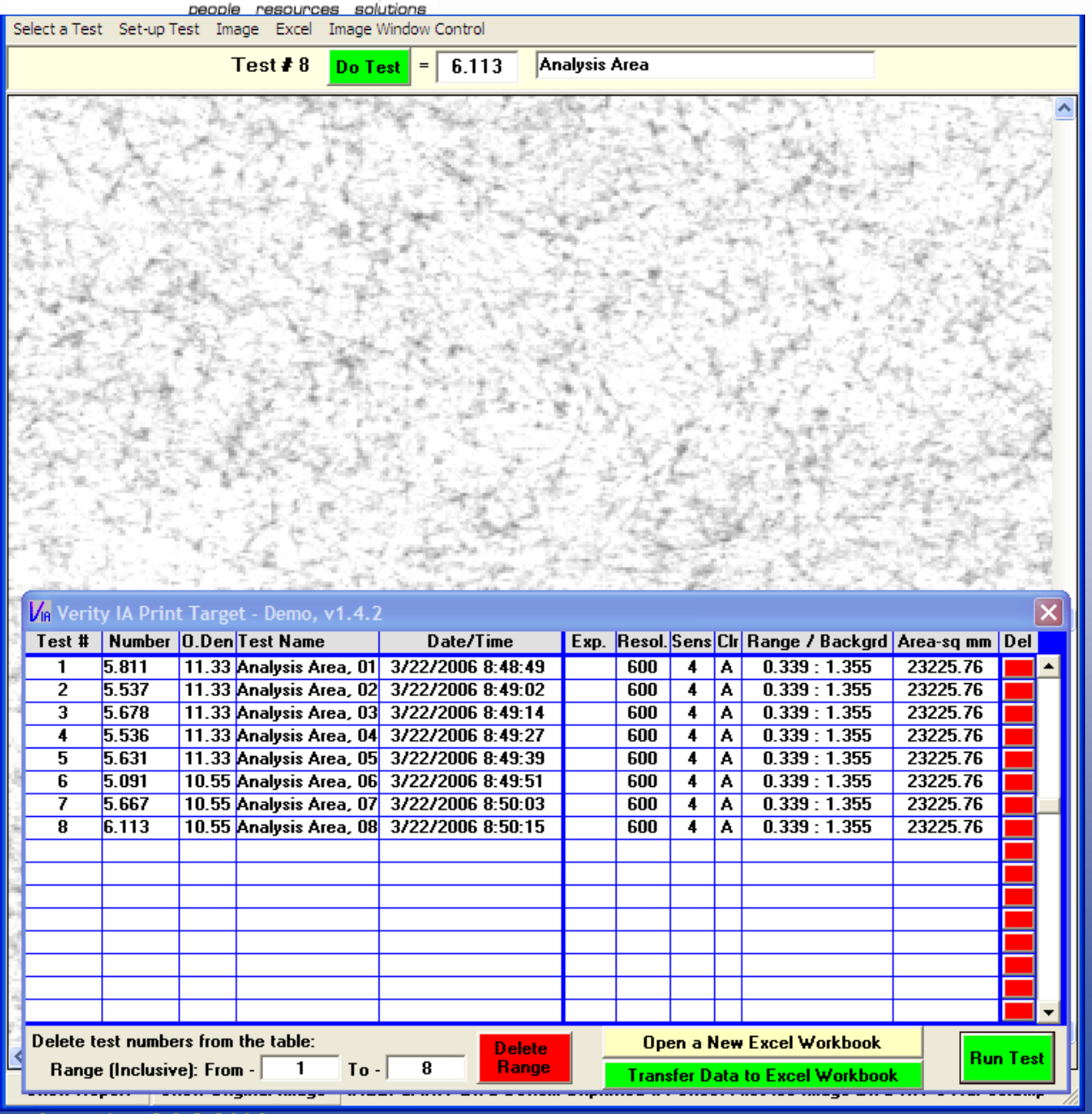
The following slides are included only to answer questions and are not a part of the presentation.

As a Research Tool



- Configure any number of tests
- With up to 30 Areas of Interest (AOI) with different settings in each
- Measure in the AOI
  - Topography
  - Mottle
  - Dots
- Extract color before measurement
- Set
  - Sensitivity
  - Brightness Shift

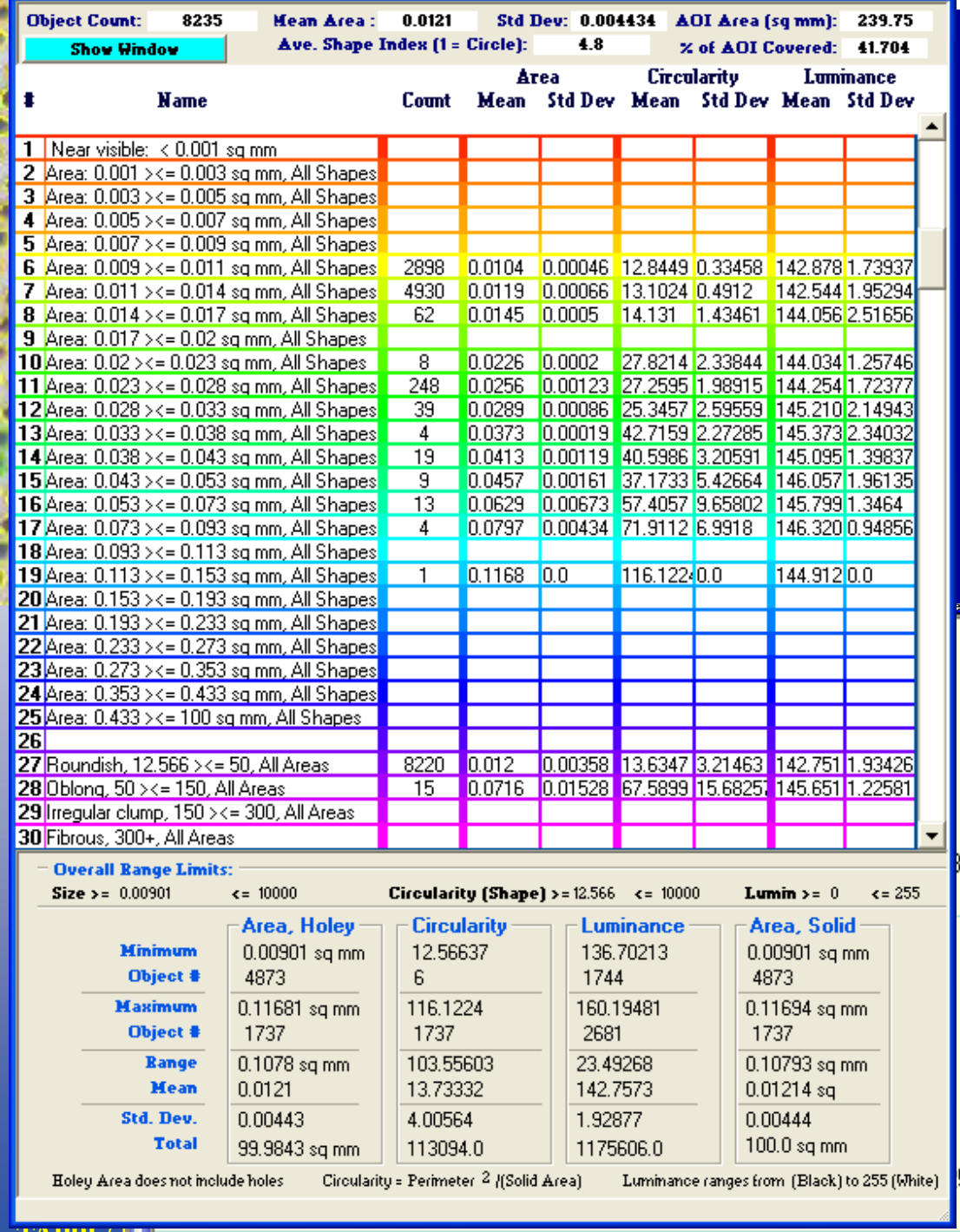
As a Production Tool



Test #	Number	O.Den	Test Name	Date/Time	Exp.	Resol.	Sens	Clr	Range / Backgrd	Area-sq mm	Del
1	5.811	11.33	Analysis Area, 01	3/22/2006 8:48:49		600	4	A	0.339 : 1.355	23225.76	
2	5.537	11.33	Analysis Area, 02	3/22/2006 8:49:02		600	4	A	0.339 : 1.355	23225.76	
3	5.678	11.33	Analysis Area, 03	3/22/2006 8:49:14		600	4	A	0.339 : 1.355	23225.76	
4	5.536	11.33	Analysis Area, 04	3/22/2006 8:49:27		600	4	A	0.339 : 1.355	23225.76	
5	5.631	11.33	Analysis Area, 05	3/22/2006 8:49:39		600	4	A	0.339 : 1.355	23225.76	
6	5.091	10.55	Analysis Area, 06	3/22/2006 8:49:51		600	4	A	0.339 : 1.355	23225.76	
7	5.667	10.55	Analysis Area, 07	3/22/2006 8:50:03		600	4	A	0.339 : 1.355	23225.76	
8	6.113	10.55	Analysis Area, 08	3/22/2006 8:50:15		600	4	A	0.339 : 1.355	23225.76	

- One Button Test
- Tests Configured by Management cannot be changed at operation level
- Data to EXCEL

Dots



Object Count: 8235 | Mean Area : 0.0121 | Std Dev: 0.004434 | AOI Area (sq mm): 239.75
Show Window | Ave. Shape Index (1 = Circle): 4.8 | % of AOI Covered: 41.704

#	Name	Area Count	Area Mean	Area Std Dev	Circularity Mean	Circularity Std Dev	Luminance Mean	Luminance Std Dev
1	Near visible: < 0.001 sq mm							
2	Area: 0.001 >< = 0.003 sq mm, All Shapes							
3	Area: 0.003 >< = 0.005 sq mm, All Shapes							
4	Area: 0.005 >< = 0.007 sq mm, All Shapes							
5	Area: 0.007 >< = 0.009 sq mm, All Shapes							
6	Area: 0.009 >< = 0.011 sq mm, All Shapes	2898	0.0104	0.00046	12.8449	0.33458	142.878	1.73937
7	Area: 0.011 >< = 0.014 sq mm, All Shapes	4930	0.0119	0.00066	13.1024	0.4912	142.544	1.95294
8	Area: 0.014 >< = 0.017 sq mm, All Shapes	62	0.0145	0.0005	14.131	1.43461	144.056	2.51656
9	Area: 0.017 >< = 0.02 sq mm, All Shapes							
10	Area: 0.02 >< = 0.023 sq mm, All Shapes	8	0.0226	0.0002	27.8214	2.33844	144.034	1.25746
11	Area: 0.023 >< = 0.028 sq mm, All Shapes	248	0.0256	0.00123	27.2595	1.98915	144.254	1.72377
12	Area: 0.028 >< = 0.033 sq mm, All Shapes	39	0.0289	0.00086	25.3457	2.59559	145.210	2.14943
13	Area: 0.033 >< = 0.038 sq mm, All Shapes	4	0.0373	0.00019	42.7159	2.27285	145.373	2.34032
14	Area: 0.038 >< = 0.043 sq mm, All Shapes	19	0.0413	0.00119	40.5986	3.20591	145.095	1.39837
15	Area: 0.043 >< = 0.053 sq mm, All Shapes	9	0.0457	0.00161	37.1733	5.42664	146.057	1.96135
16	Area: 0.053 >< = 0.073 sq mm, All Shapes	13	0.0629	0.00673	57.4057	9.65802	145.799	1.3464
17	Area: 0.073 >< = 0.093 sq mm, All Shapes	4	0.0797	0.00434	71.9112	6.9918	146.320	0.94856
18	Area: 0.093 >< = 0.113 sq mm, All Shapes							
19	Area: 0.113 >< = 0.153 sq mm, All Shapes	1	0.1168	0.0	116.122	0.0	144.912	0.0
20	Area: 0.153 >< = 0.193 sq mm, All Shapes							
21	Area: 0.193 >< = 0.233 sq mm, All Shapes							
22	Area: 0.233 >< = 0.273 sq mm, All Shapes							
23	Area: 0.273 >< = 0.353 sq mm, All Shapes							
24	Area: 0.353 >< = 0.433 sq mm, All Shapes							
25	Area: 0.433 >< = 100 sq mm, All Shapes							
26								
27	Roundish, 12.566 >< = 50, All Areas	8220	0.012	0.00358	13.6347	3.21463	142.751	1.93426
28	Oblong, 50 >< = 150, All Areas	15	0.0716	0.01528	67.5899	15.6825	145.651	1.22581
29	Irregular clump, 150 >< = 300, All Areas							
30	Fibrous, 300+, All Areas							

Overall Range Limits:

Size >= 0.00901 <= 10000 | Circularity (Shape) >= 12.566 <= 10000 | Lumin >= 0 <= 255

	Area, Holey	Circularity	Luminance	Area, Solid
Minimum	0.00901 sq mm	12.56637	136.70213	0.00901 sq mm
Object #	4873	6	1744	4873
Maximum	0.11681 sq mm	116.1224	160.19481	0.11694 sq mm
Object #	1737	1737	2681	1737
Range	0.1078 sq mm	103.55603	23.49268	0.10793 sq mm
Mean	0.0121	13.73332	142.7573	0.01214 sq
Std. Dev.	0.00443	4.00564	1.92877	0.00444
Total	99.9843 sq mm	113094.0	1175606.0	100.0 sq mm

Holey Area does not include holes | Circularity = Perimeter ^{2} /(Solid Area) | Luminance ranges from (Black) to 255 (White)

Analyze Dots

Individual properties

Color extraction

Statistics on:

- Area, Holey (Flex & Roto)
- Shape, (all print methods)
- Luminance within the dot (Ink distribution)

Color Extraction

Ave. of All (K)

Red (R) | Green (G) | Blue (B)

Cyan (C) | Magenta (M) | Yellow (Y)

255

Auto-Find Optimum Color

Dot & Speck Analysis Set-up

Background (Image Mode) = 200

Offset from AOI background = -20

Set Size, Shape, Lumin Filters

Show Threshold Image | Show Report

255

Active AOI: 4

Zoom: 2.0

Apply Settings