



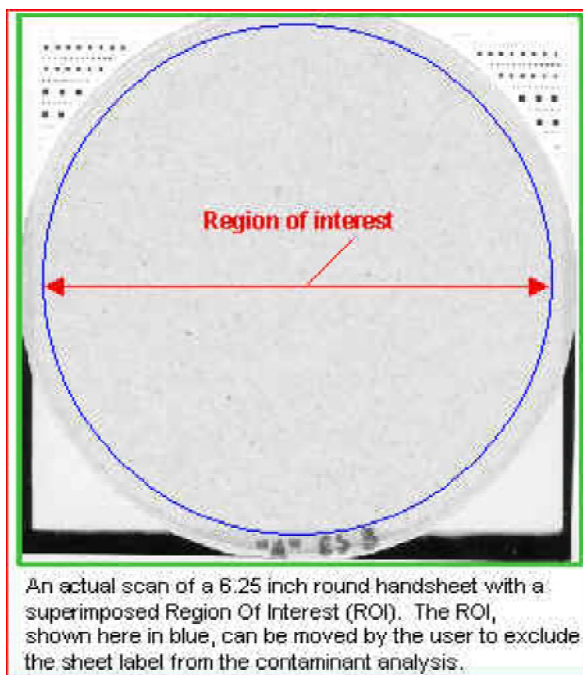
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VERITY IA® employs the latest in image analysis techniques to produce high accuracy measurements of all visible contaminants in paper and pulp. A conventional off the shelf high resolution color document scanner is used with a modern desktop computer running WINDOWS 95, 98, NT, 2000, or XP fitted with 256 meg memory. Data are displayed on screen and recorded in a standard Microsoft EXCEL spread sheet. Most paper labs now have the basic equipment.

VERITY IA® Dirt Count can be used with the RMD Wet Specimen technique. See [RMD Wet Specimen Technique](#)

VERITY IA® is different.

Analysis begins with a handsheet or other flat specimen containing contaminants that visibly contrast with their surroundings. A high resolution specimen image is acquired by a TWAIN compliant scanner and placed in the computer memory from which it is subsequently internally transferred to an image analysis application. By bringing the entire image into the computer memory it can be analyzed as many times as necessary to extract data about size, shape, and color (when used). A Region Of Interest (ROI) is traced in the image to define the region for image analysis. The ROI can be moved to exclude areas not to be measured such as labels. If the specimen is damaged a freehand ROI can be drawn to exclude those damaged portions.



Standardization:

The first step in the analysis process is to inspect a reference area and calculate the intensity of each color band. The results of consecutive scans are compared to an internally stored tolerance level. If the differences exceed the preset calibration limit the sequence is repeated until the deviation is removed or the operator is alerted in the event the calibration fails.

HIGH SENSITIVITY

By default VERITY IA® finds just about everything that contrasts with the background by at least 10% in reflectivity. VERITY IA® can be desensitized but this high sensitivity threshold is currently recommended by TAPPI T-563. Although we recommend a high sensitivity be used, the sensitivity is adjustable. The normal range is between 8% and 35% of the background reflectivity. Most dirt counters in current use are set at about 25%.

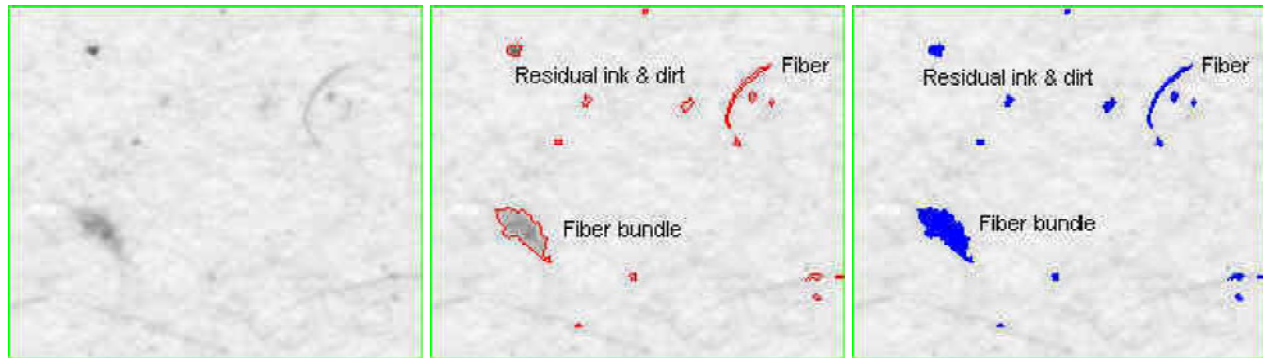
The term "Contrast" may be confusing to those using dirt counters. A low contrast speck will appear to be very

light gray or pastel when viewed against a white background. A high contrast speck is very dark against a white background. In reflectivity terms contrast is the difference between the percent background reflectivity (0-100%) and the average speck reflectivity (0-100%).

When using VERITY IA®, dirt count images are acquired in an 8 bit format which provides a digitized image in 256 gray value increments. Unlike a dirt counter, VERITY IA® brings the entire scanned image into the computer memory where first it evaluates the image background and calculates the overall image background gray value. Using the % contrast setting the threshold gray is then calculated from the background gray value.

$$\text{Threshold gray value} = \text{Background} * (1 - \text{Contrast})$$

The resulting threshold value can range between 0 and 255. All image picture points equal to or less than the threshold will be considered to be a part of a speck.



The above shows a typical extraction and classification where the object is first extracted from the background and the perimeter is determined (Red) using the calculated threshold. The area within the perimeter is then calculated (Blue).

PYTHAGOREAN AREA

VERITY IA® can employ several different area measurement techniques. In one of them the area of the object is calculated using Pythagorean principles of polygon areas. This technique works because the center of pixel point to point connections are made to trace the outline of an object rather than using the older technique of connected square spatial pixels. By tracing the outline of the object a better approximation of its size (Area), perimeter, and average reflectivity can be made.

VERITY IA® automatically places all data in a Microsoft EXCEL spread sheet. This is an extract from a typical report:

Test name: Demonstration
Date, Time: Tue May 05 17:28:36 1993

Size Category =>sq mm	=<-sqmm	Count	Area sq mm	Ave. Size sq mm	FPM by Category	Cumulative PPM (Declining)	EBA Calculations			Average Circularity	Circularity Std Dev	Shape Index
							category EBA	EBA PPM each Size Category	EBA PPM >=Size Category			
0.020	0.03	12	0.313	0.026	374.1	11912.8	0.031	36.7	1717.1	38.2	10.9	0.4
0.03	0.04	7	0.252	0.036	301.2	11538.7	0.025	29.9	1380.5	35.1	12.3	0.4
0.04	0.05	4	0.182	0.045	217.6	11237.5	0.018	21.9	1350.6	50.2	15.3	0.8
0.05	0.06	2	0.110	0.055	131.9	11019.8	0.011	13.2	1328.6	52.4	3.1	0.2
0.06	0.07	4	0.265	0.066	317.3	10868.0	0.029	35.0	1315.4	49.1	21.1	1.0
0.07	0.08											
0.08	0.09	1	0.082	0.082	97.6	10670.7	0.010	12.3	1560.3	24.2		
0.09	0.10	2	0.188	0.094	225.1	10473.1	0.021	25.2	1568.1	39.9	26.1	1.0
0.10	0.15	2	0.217	0.108	269.4	10248.0	0.024	26.4	1542.8	69.2	12.0	0.8
0.15	0.20	4	0.684	0.171	317.9	9968.6	0.075	69.8	1514.4	40.6	15.8	0.6
0.20	0.25											
0.25	0.30											
0.30	0.40	1	0.313	0.313	374.1	9170.7	0.046	54.6	1424.6	23.3		
0.40	0.60	1	0.464	0.464	555.3	8796.6	0.054	65.1	1370.0	29.6		
0.60	0.80	3	2.157	0.719	2580.2	8241.3	0.285	341.2	1304.8	44.3	4.7	0.2
0.80	1.00											
1.00	1.50											
1.50	2.00											
2.00	3.00	2	4.732	2.366	5661.1	5661.1	0.805	963.6	663.6	63.8	38.0	2.4
3.00	100.00											
Totals		45	9.959	0.221	11912.8		EBA PPM	1717.1				

CONTAMINANT CLASSIFICATION BY SHAPE

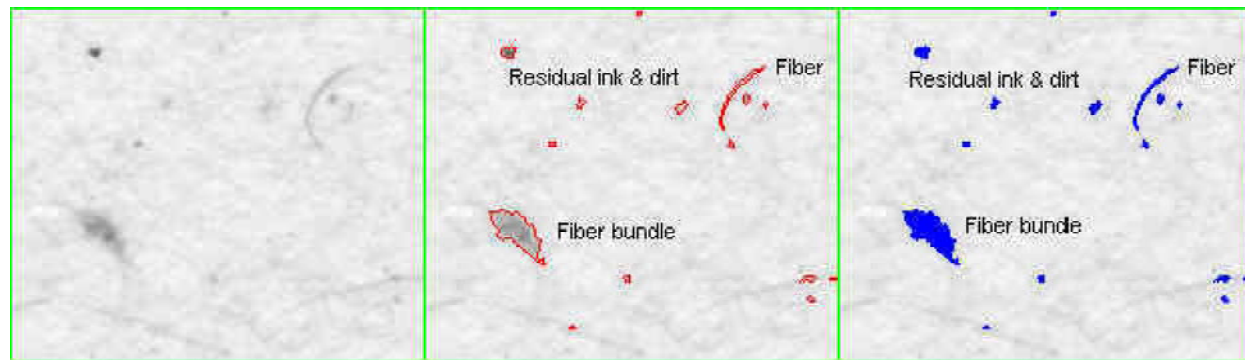
With this high sensitivity VERITY IA® finds things that were not easily classified using older technology; things such as fibers and shives as distinguished from residual ink. The resulting high dirt counts are further classified by shape. To detect and classify by shape, VERITY IA® traces the outline of each contrasting object in the image by connecting the center of the picture points on the edge of the object to form a polygon on the perimeter of each speck.

PYTHAGORUS SURVIVES!

The characteristics of the polygon VERITY IA® traces on the speck perimeter are then used to classify the object as a fiber, bundle, shive or residual ink. One very simple relationship, circularity, is used to define the speck shape by using the speck area and the square of its perimeter:

$$\text{Circularity} = \text{Perimeter}^2 / \text{Area}$$

This relationship can also be used to detect ragged objects like fibrillated fiber bundles.



A fiber clump isolated from the residual ink and identified using the circularity criterion.



The above shows a typical extraction and classification where the object is first extracted from the background and the perimeter is determined (Red). The area is then calculated (Blue).

Following is an extraction from a typical Verity IA® generated Microsoft EXCEL report showing the shape classes defined by the user:

Contaminants classes	Count	Area sq mm	Ave. Size sq mm	Average Gray Value	PPM by Category	Cum PPM (Declining)	User defined *Circularity Range	
							Low	High
Round dirt	18	1.578	0.088	154	1887.73	11912.80	=>12.56	35
Clumps	13	5.308	0.408	152	6350.35	10025.06	=>35	50
Wide fibers	14	3.072	0.219	155	3674.72	3674.72	=>50	100
Individual fibers							=>100	10000
Totals	45	9.958	0.221					

*Circularity = Perimeter sq / Area. The lowest is 12.56 (4Pi), a circle. A square is 16:
The highest circularity approaches infinity for a long thin straight fiber.

CALIBRATION

VERITY IA® calibrates the scanner by separately evaluating the response from each of the three color bands , red, green, and blue, used by the scanner to create an image. By evaluating the difference between successive scans of each color band intensity and comparing the individual variations to a tolerance level the scanner can be brought into equilibrium on a repeatable basis before making a quality scan.

To create a gray image some scanners will sum the intensity of each color band others will simply turn on the green sensor to acquire a gray scale image. Because it is TWAIN compliant, VERITY IA® works with both methods. All color scanners, when making a color scan, create a color image using each color sensor separately.

SIMPLE OPERATION, SINGLE BUTTON

All of these features are standard with the VERITY IA® image analysis system. In spite of their apparent complexity the operator only has to push one button to activate the entire sequence which takes considerably less than one minute to complete.

If you have questions or suggestions please write us at info@VerityIA.com or call us at 1-800-677-0810 or 1-920-886- 3630 for more information about demonstrations and trials. Our fax is 1-920- 886- 3631. Our home base is 691 S. Green Bay Rd. Suite 120, Neenah, WI 54956