Pædia[®] *ColorShopTools* ™

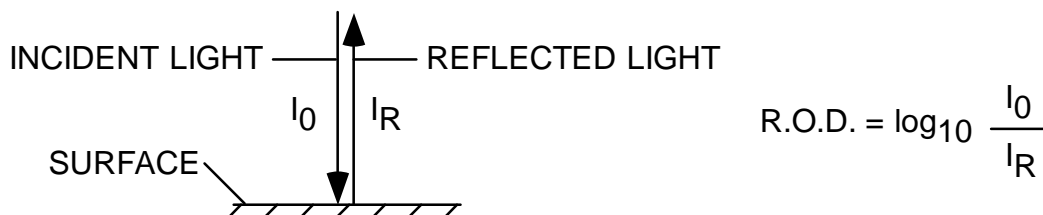# X-Rite® brand Model 404 Densitometer Utility

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Introduction

The *Pædia ColorShopTools* software utilities provide graphical user interfaces to a variety of products which are used in the printing industry. The CST404 program connects to the X-Rite brand Model 404 densitometer to make data-taking simple and error-free.

The *Pædia ColorShopTools* software is semi-automatic. It helps the operator maintain consistent experimental methods in measurement-taking, removing a primary variable from the equation required for consistent prints.

Measuring Reflection Optical Density

Reflection Optical Density (**R.O.D.**) is defined as follows:

INCIDENT LIGHT ———— REFLECTED LIGHT

I_0 I_R

SURFACE

$$\text{R.O.D.} = \log_{10} \frac{I_0}{I_R}$$

The reflective optical density of a surface equals the base-ten logarithm of the ratio of the incident and reflected light intensities. This ratio can be specified at a single wavelength or over a range of

wavelengths. It can be measured at a point or over an area. It can also be measured perpendicular to the surface (as in Fig. 1), or at an angle.
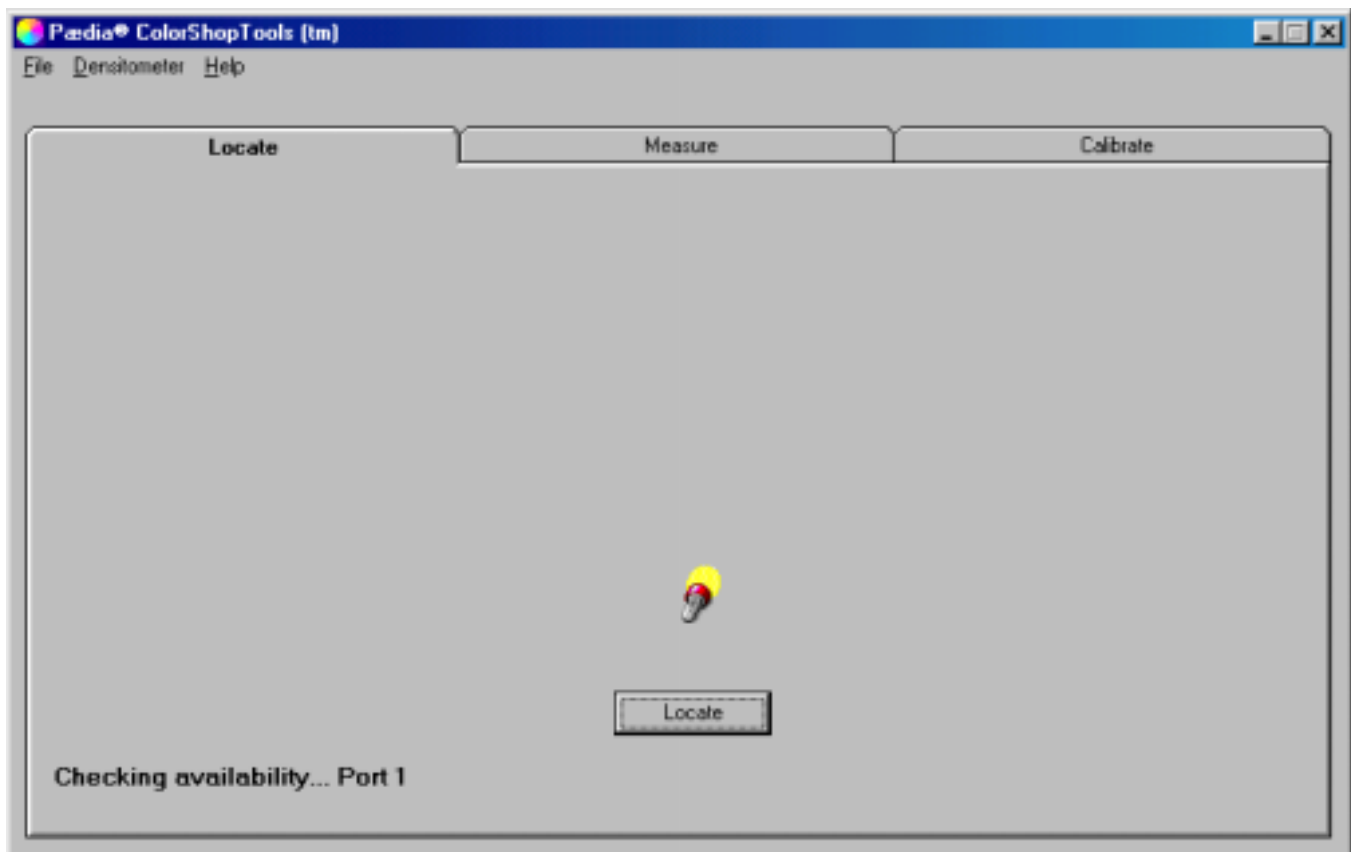
Practical considerations require that the reflected light intensity be measured at a slight angle, and over a finite area. In the case of the present instrument, this area is a circle about 2 millimeters in diameter.

In most printing applications of densitometers the incident light is white, including a wide range of wavelengths from violet to red. The reflected light intensity is measured by several photodetectors, each with a filter having a tailored wavelength range. Comparison of the light levels reaching the individual photodetectors is used to determine the relative components of standard subtractive primary colors, cyan (C), magenta (M), and yellow (Y). When the intensities of the three components C, M, and Y are equal, the result is gray—somewhere between white and black. This value is reported as the "V" value. The measurements described below are all derived from this simple concept.
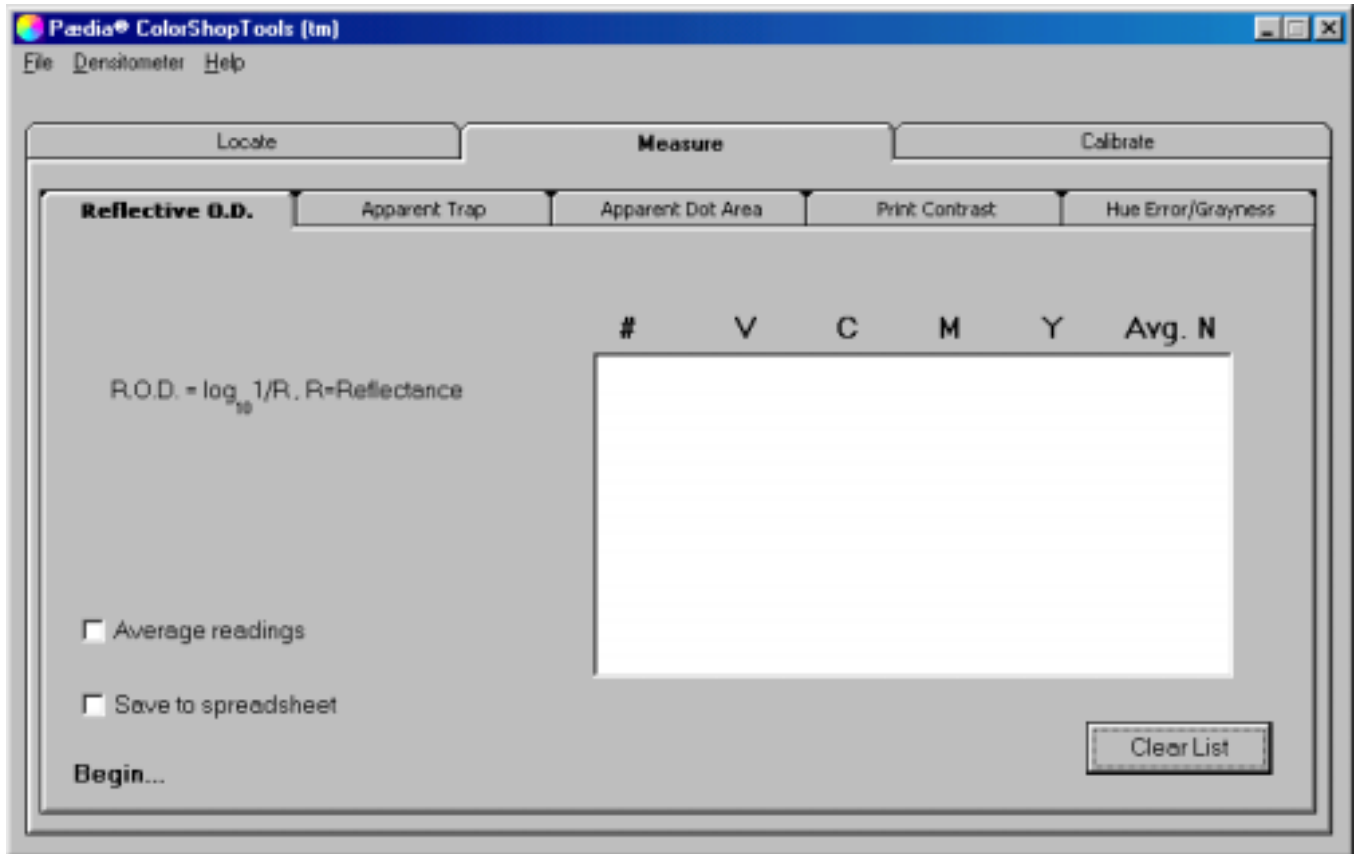
Starting the Program

From the Windows "Start" menu, select CSTXR404. The following screen will appear.

The CST404 utility program comprises three major components: "Locate", "Measure", and "Calibrate". These are organized in tabs for easy navigation through the program. The lower, left-hand corner of each tab contains information and prompts to guide you. For example, when the program is first started, it automatically searches all ports on your computer until it finds the densitometer. Progress is indicated on the prompt line. When the densitometer is found, the following screen appears. The model of the densitometer and its firmware version are displayed, along with information about the serial port connection. The prompt line at the lower left indicates that the system is ready to take measurements.
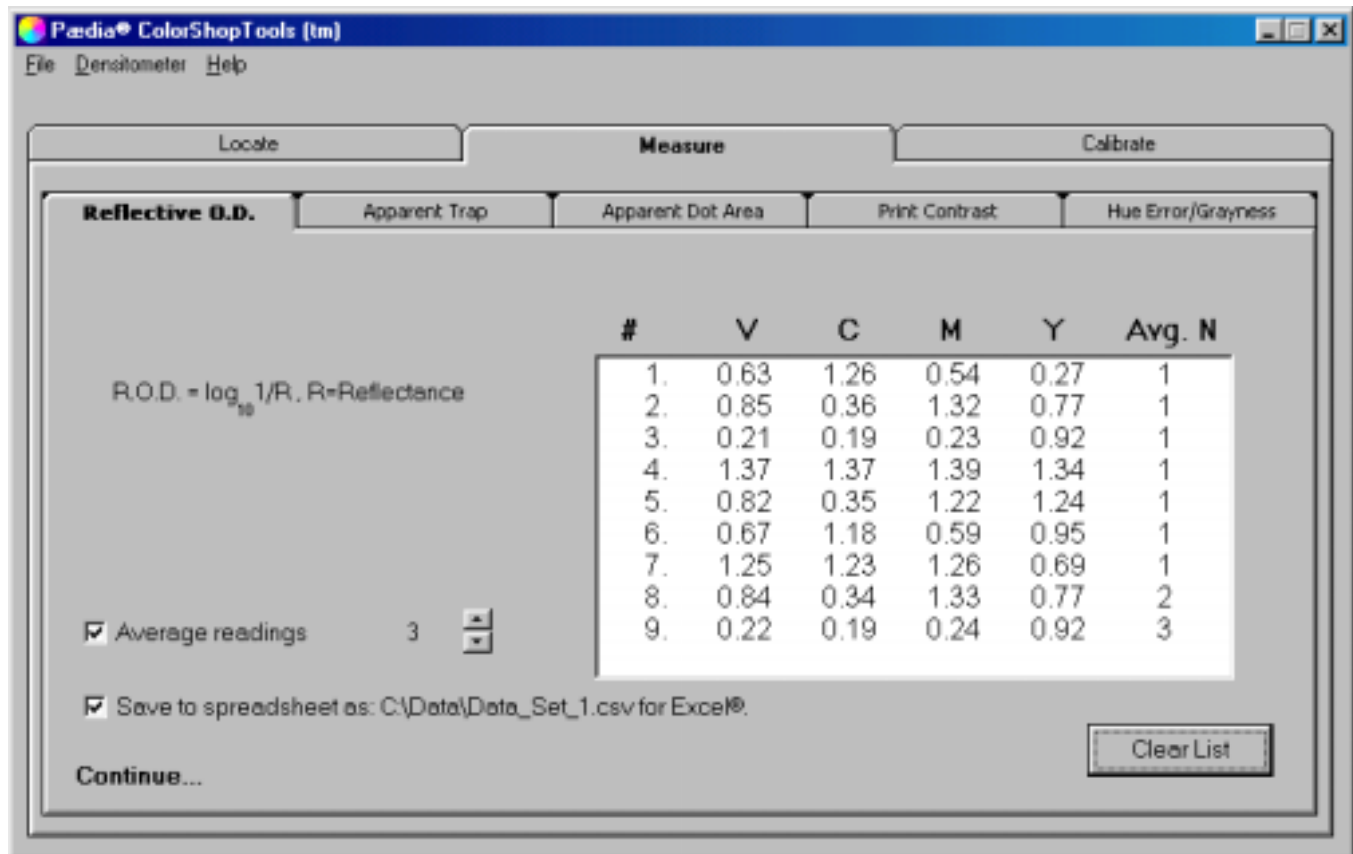

Click on "Measure". The following screen will appear. Five measurements are available: R.O.D., Apparent Trap, Apparent Dot Area, Print Contrast, and Hue Error/Grayness.

Reflective Optical Density

The formula at the left side of the tab is an alternate definition of R.O.D. Reflectance is the ratio of the incident and reflected light intensities. Notice that the prompt line indicates "Begin…". To measure the R.O.D. of a surface, press the densitometer down against the surface and hold it there until the densitometer display indicates a reading. The sequential number of the reading is followed by all four density values V, C, M, and Y.

Click "Average readings" to record the average of two or more readings. Click on the UP/DOWN buttons to select the number of readings to average. You will be prompted for the remaining readings. The right-hand column on the list indicates the number of samples which were averaged for each reading. Turn "Average readings" ON and OFF as needed.

Click "Save to spreadsheet" to save subsequent measurements. <u>The present screen will be cleared.</u> A "Save As" dialog box will appear. Enter a file name and click on "Save". The data are saved in "CSV" (comma-separated variables) format, ready for use in your Excel® spreadsheet. If you have Excel software on your computer, double-click on the *.CSV icon to open a data set.

Click "Clear List" to discard all data on the list.

Apparent Trap

Apparent trap is an indication of how well a second ink overlays a first, compared to the way the paper accepts that ink. Apparent trap is generally expressed as a percentage. It is defined as follows:
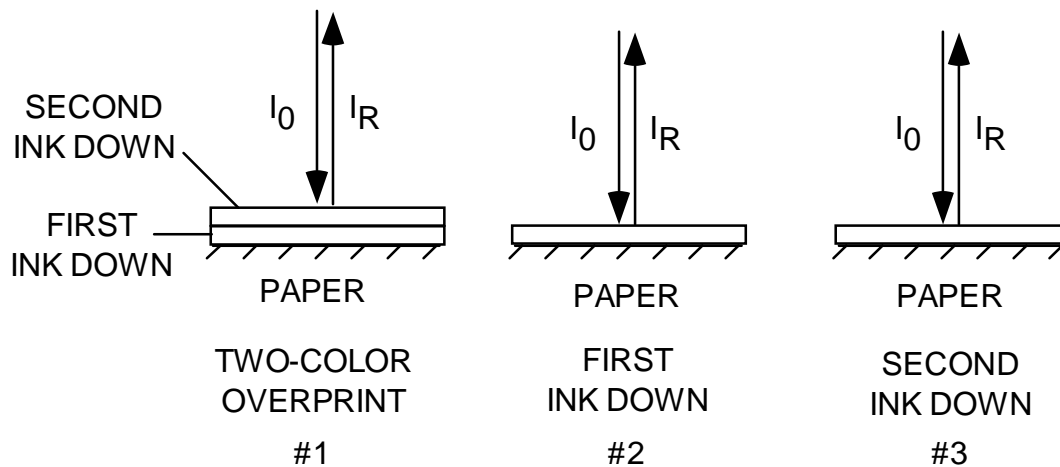
$$\% \text{ Apparent Trap} = \frac{D_{\text{2-COLOR}} - D_{\text{FIRST INK DOWN}}}{D_{\text{SECOND INK DOWN}}}$$

where:

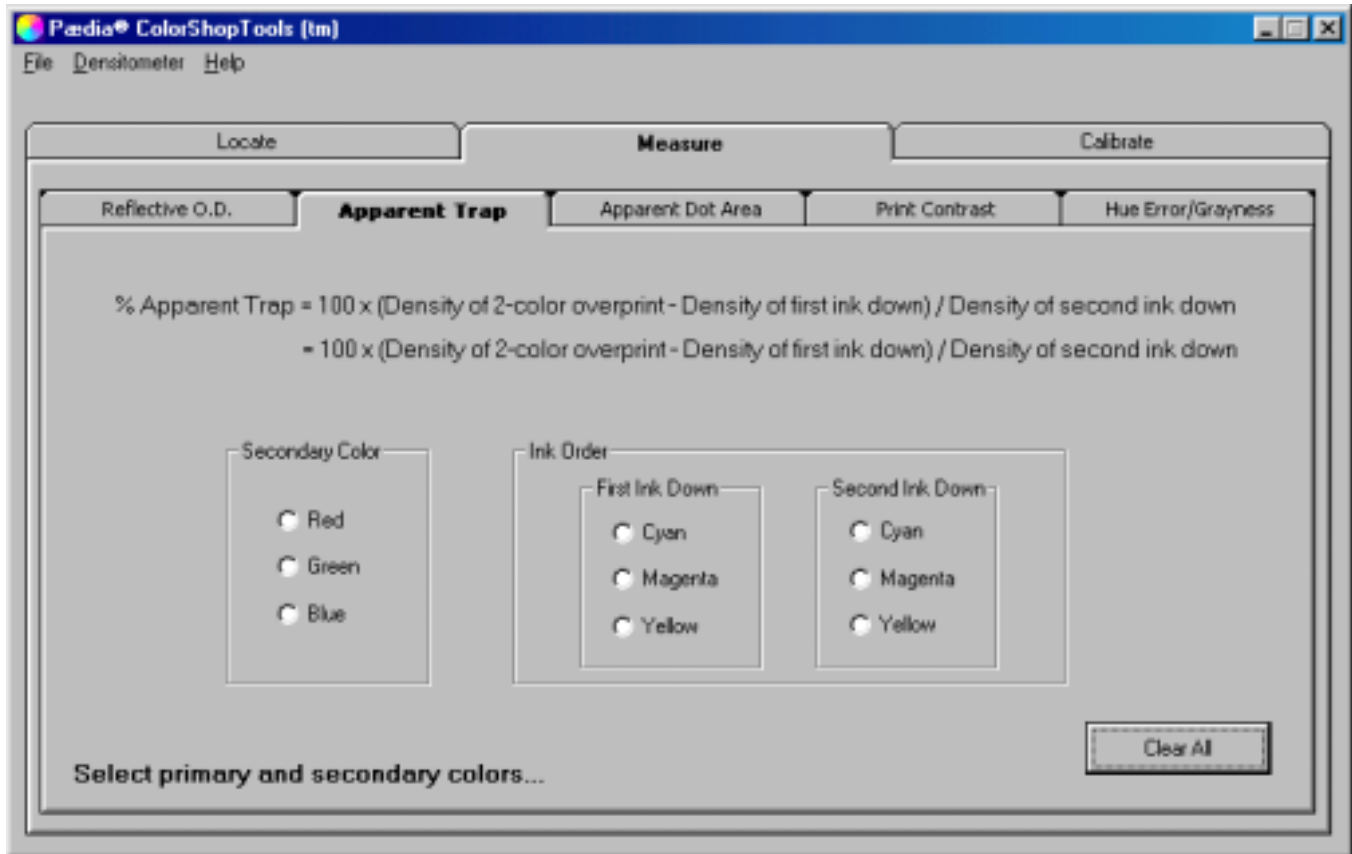$D_{\text{2-COLOR}}$ = Density of the two-color overprint,

$D_{\text{FIRST INK DOWN}}$ = Density of the first ink down, and

$D_{\text{SECOND INK DOWN}}$ = Density of the second ink down.

The Apparent Trap tab is organized for rapid reading of red, green, and blue trap data. These are the colors of greatest interest for three and four-color printing. Select the overprint color, then select the first and second inks down. Follow the instructions on the information line.

Click on "Clear All" to start a new measurement.

Apparent Dot Area
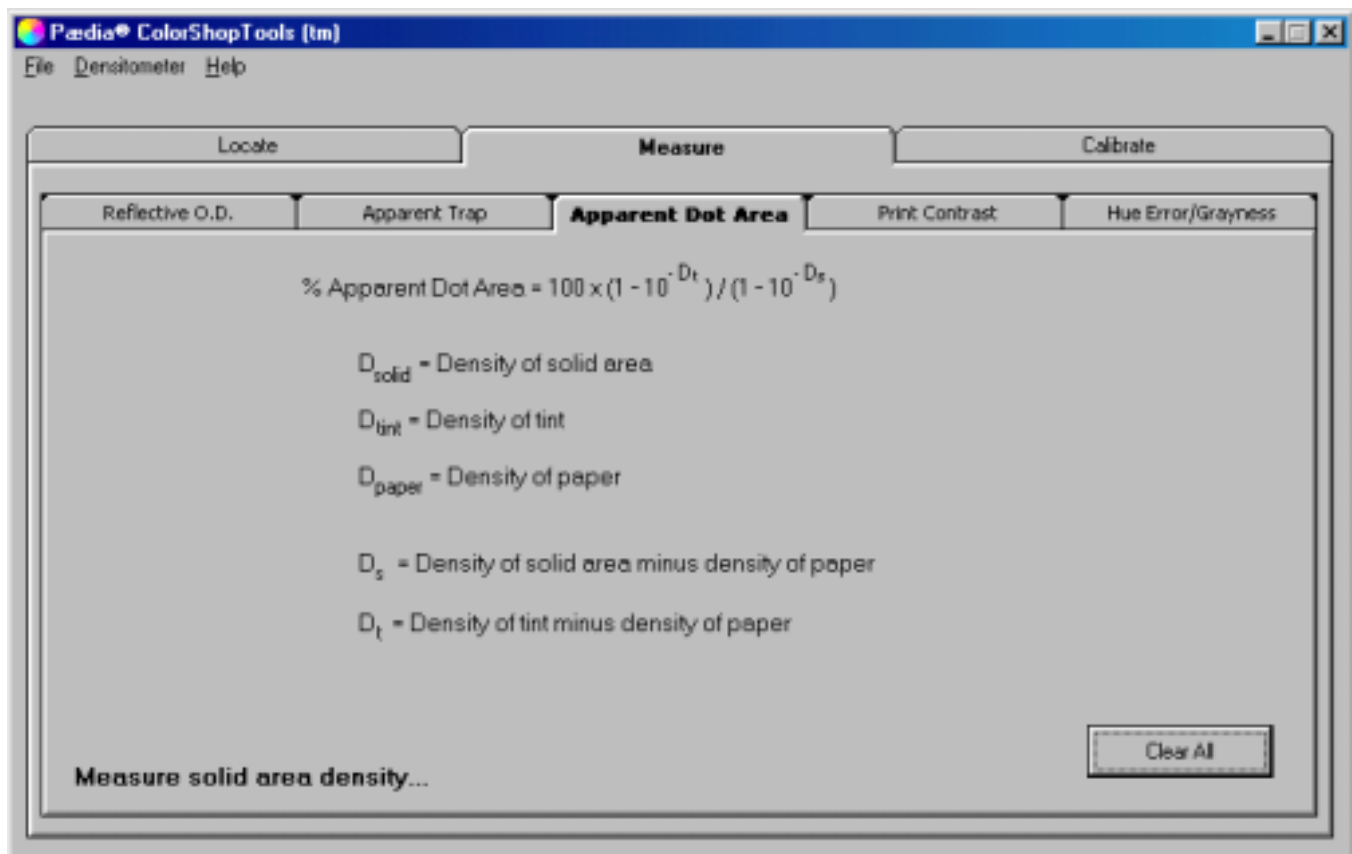
Apparent dot area is defined as follows:

$$\text{Apparent Dot Area} = 100 \times \frac{1 - 10^{-D_{tint}}}{1 - 10^{-D_{solid}}}$$

where:

D_{tint} = the density of the tint primary minus the density of the paper, and

D_{solid} = the density of the solid primary minus the density of the paper.

Measured in reflectance on the receiving surface (usually paper), Dot Area is one factor used in determining Dot Gain. The original size of a halftone dot on film differs from that of the same dot when it is printed on paper. This is due to spreading and absorption of the ink. The original density of dots on film is measured using a *transmission* densitometer (not the Model 404). The final density of the dots is measured on the receiving surface using the Model 404 *reflection* densitometer. The apparent dot area on paper is then compared to the original dot area on the film. The difference between the two is the Dot Gain.

Print Contrast

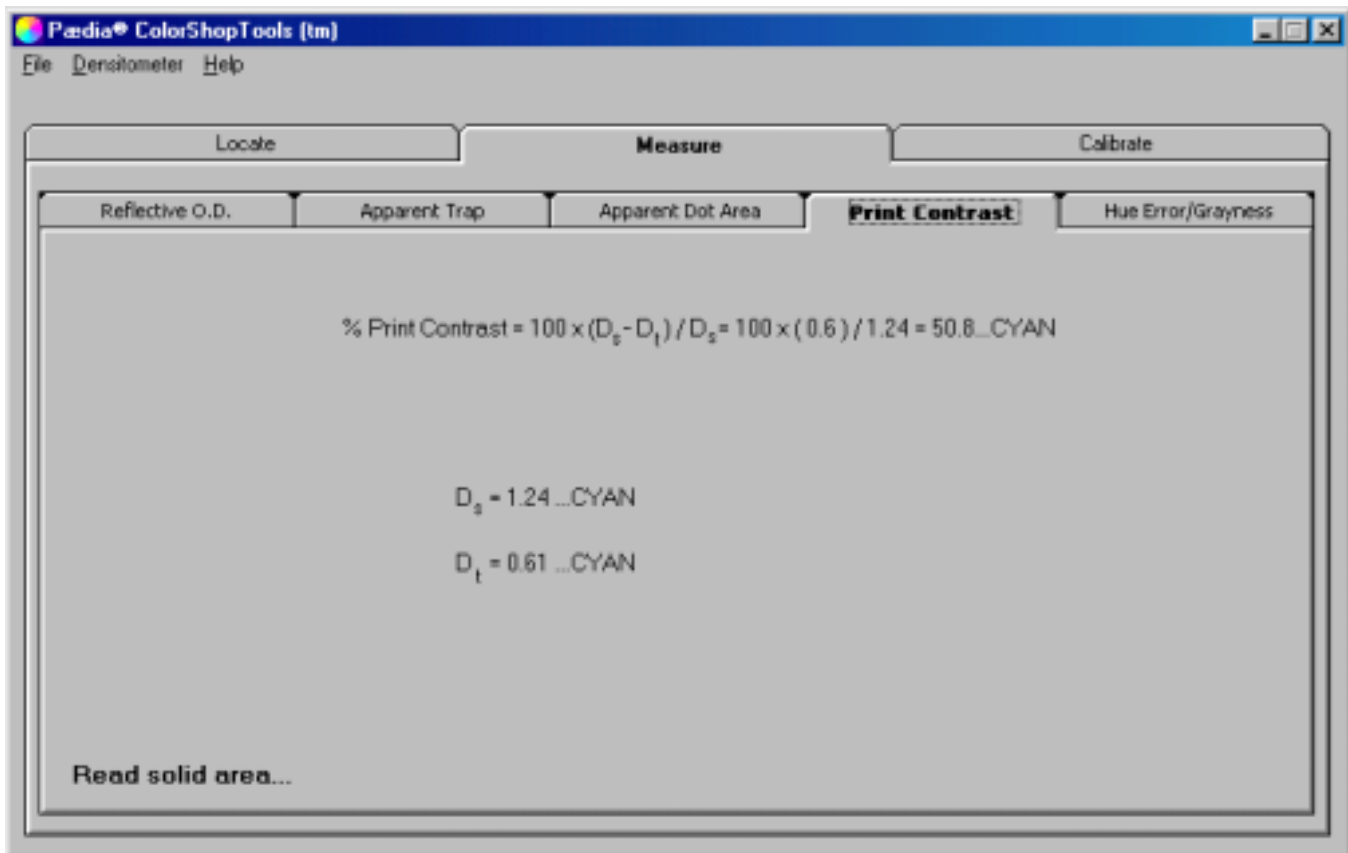Print contrast is defined *for each primary color* as:

$$\% \text{ Print Contrast} = 100 \text{ x } \frac{D_{solid} - D_{tint}}{D_{solid}}$$

where:

D_{solid} = Density of the solid area, and

D_{tint} = Density of the tint area.

Follow the prompts to make the measurement.

Use Print Contrast measurements to specify the light-to-dark ratio, or contrast of any primary color. Follow the prompts to measure a given primary color in shadow and light areas. High contrast images "pop" off the paper, while low contrast areas are "flat".

Hue Error and Grayness

Hue error and grayness can be measured at the same time. They are defined as follows:

$$\% \text{ Hue Error} = 100 \text{ x } \frac{D_M - D_L}{D_H - D_L} \qquad\qquad \% \text{ Grayness} = 100 \text{ x } \frac{D_L}{D_H}$$
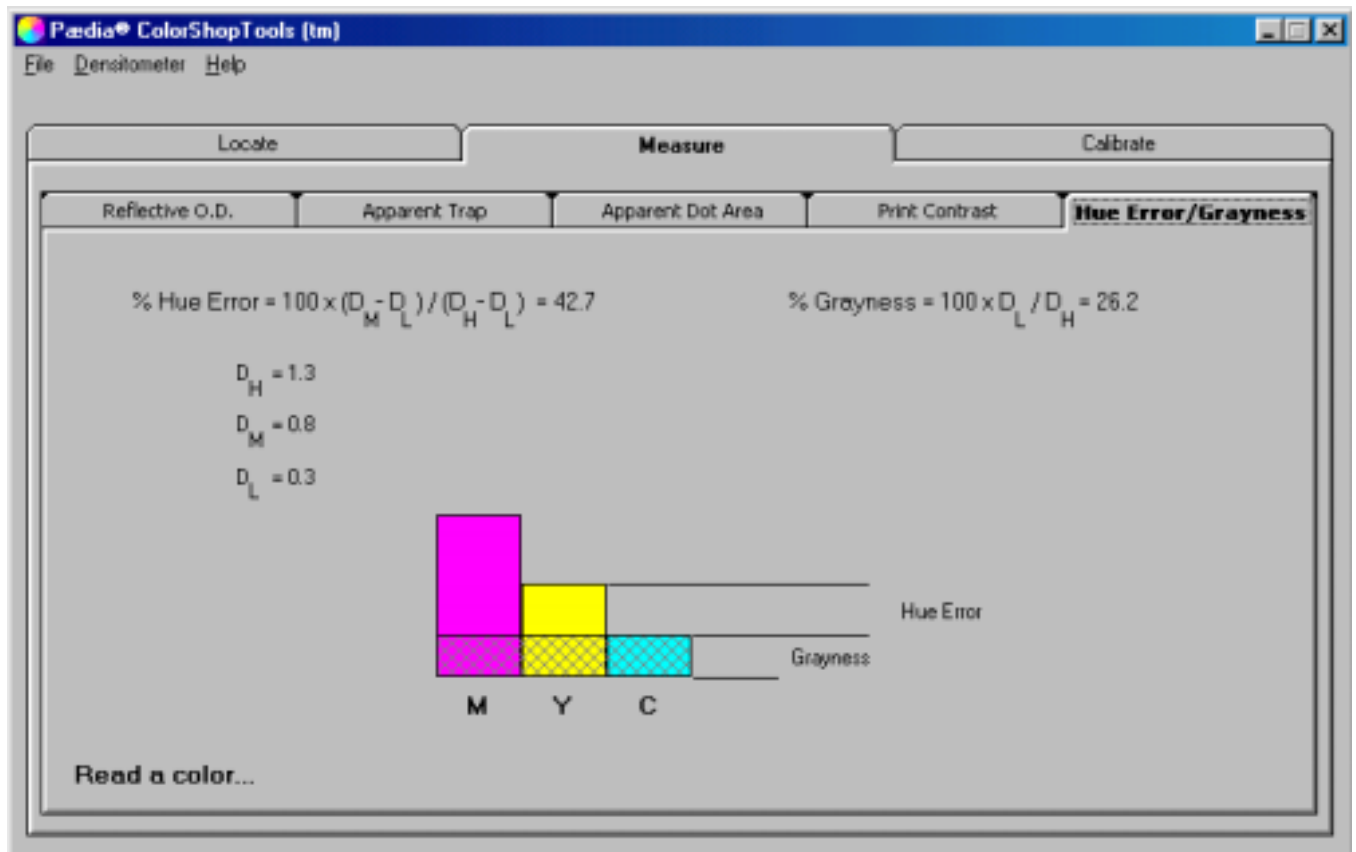
where:

D_L = the lowest density value in the measurement,

D_M = the middle density value in the measurement, and

D_H = the highest density value in the measurement.

Hue error is a measurement of the deviation from a "perfect" primary color. In practice, any primary color contains at least some amount of the other primaries.
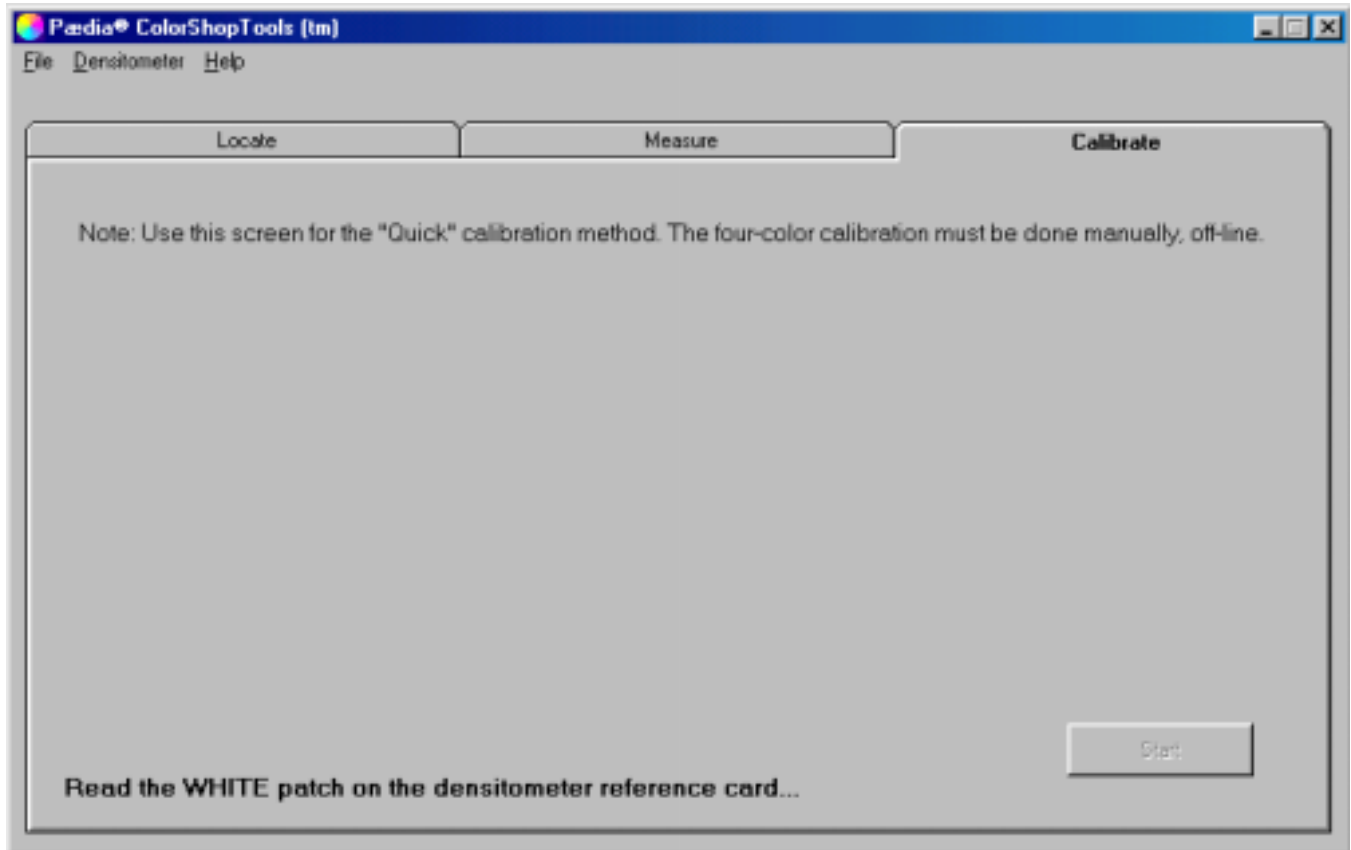
Grayness indicates the amount of gray in any color—the fraction of the overall density which contains equal amounts of cyan, magenta, and yellow.
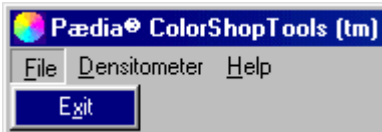
Calibration

Perform the four-color calibrations manually, without the use of the *ColorShopTools* Utility. Only the "Quick" calibration method is available in this program.

Click on the "Calibrate" tab. Press the "Start" button to start the calibration routine. You will be prompted to read the white patch on your calibration card. This completes the "Quick" calibration.
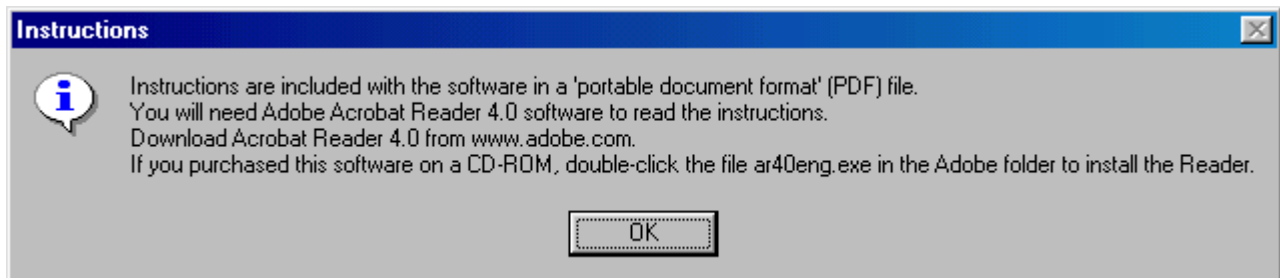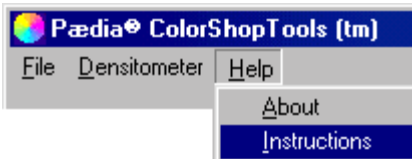
The Command Line

Select "Exit" to leave the program.

Select "Reset" to reset the densitometer. Do this whenever the densitometer's buttons don't respond. Note: If the densitometer's buttons don't respond, reset it manually: (1) disconnect the densitometer's power cord, (2) wait for the display to go blank. The next time you use it, the densitometer will reset itself.

Instructions can be viewed using Adobe Acrobat 4.0. This program is available free of charge at www.adobe.com.

Technical Support

We have written these instructions for completeness and ease of understanding. If, after reviewing the manual, you still require technical assistance with the ColorShopTools software, contact Pædia Corporation at one of the following (phones are answered between 9:00 a.m. and 5:00 p.m., U.S. West Coast time):

International phone	415-861-8098
US phone	800-889-9398
International fax	415-861-6683
e-mail	support@paedia.com

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Relationship

Paedia Corporation is a reseller of X-Rite products. There is no other relationship between Paedia Corporation and X-Rite, Incorporated.

Appendix A—Installation

Installing the Software

From the internet:

1. Download the CST_XR404.EXE package from the Pædia Corporation website: www.Pædia.com. This is a self-extracting file.

2. Double-click on the CST_XR404.EXE icon and follow the prompts. We recommend placing the files in a new folder in your C:\TEMP\ directory.

3. Double-click on Setup.exe. You will be offered several choices. Accept all defaults. The software installation is complete.

From the CD-ROM:

1. Double-click on Setup.exe. You will be offered several choices. Accept all defaults. The software installation is complete.

From floppy diskettes:

1. Copy the contents of all the floppies to a folder on your hard disk. We recommend making a new folder, C:\TEMP\CST\.

2. Double-click on Setup.exe. You will be offered several choices. Accept all defaults. The software installation is complete.

Un-installing the software:

1. In your computer's **Control Panel**, double-click on **Add/Remove Programs**.

2. Locate the CST_XR4 title.

3. Click **Remove**.

Required Hardware

The following hardware is required:

1.Your densitometer: X-Rite brand Model 404.

2. A modular cable.

3. A cable adapter.

4. A 9-25 pin serial port adapter (Some computers may not require this.)

Items 2, 3, and 4 are available as a kit from X-Rite, Incorporated or from Pædia Corporation.

Connecting the Hardware

Take care to avoid static electricity discharges.

1. Plug the modular cable into your densitometer.

2. Plug the other end of the modular cable into the cable adapter.

3. Plug the cable adapter into your computer's serial port. You will probably need to use the 9-25 pin adapter, too.

Further Reading

Find additional information in "A guide to Understanding Graphic Arts Densitometry", by X-Rite, Inc., and on their website at www.xrite.com.