NPIRI TECHNICAL CONFERENCE

Bronzing of Prints

A Study by the NPIRI Color Measurement Task Force

Presented by

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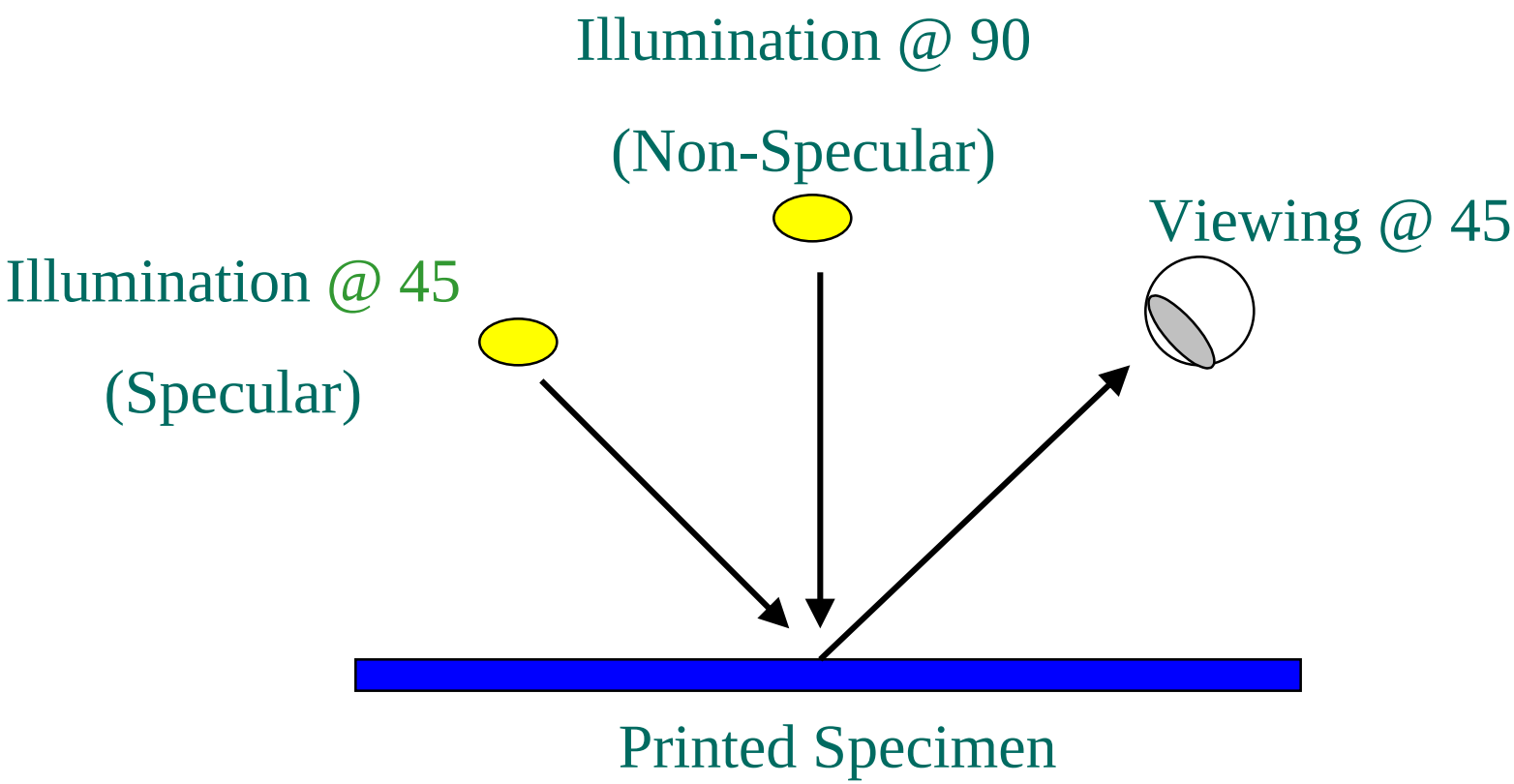
What is Bronzing?

- ***Bronzing is a phenomenon in which the appearance of a print of a strong ink made with certain pigments will change color dramatically when it is viewed at angles near the specular.***
- ***It is observed most at high pigment loadings and with specific pigments.***
- ***Bronzing can be desirable in some inks or a problem when not wanted.***

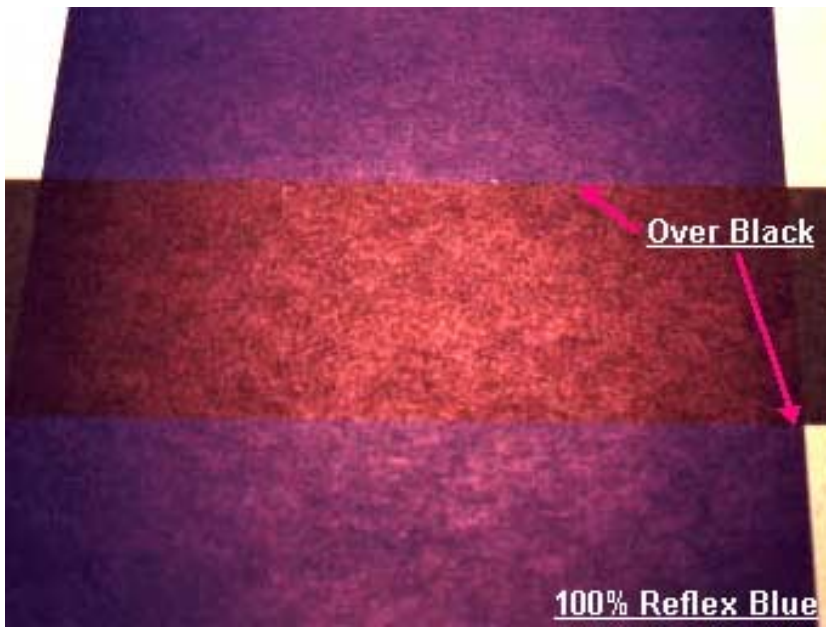
What is Bronzing?

- *It often has a coppery metallic color, similar to bronze alloys.*
- *The Chroma of the bronze color will increase as viewing ----> specular*
- *The Hue of the bronze color will change as viewing ----> specular*
- *Some common bronzy ink pigments are: PB-61,56,27,15 & PR-52.1,57.1*

Schematic of Setup for Bronze Observations



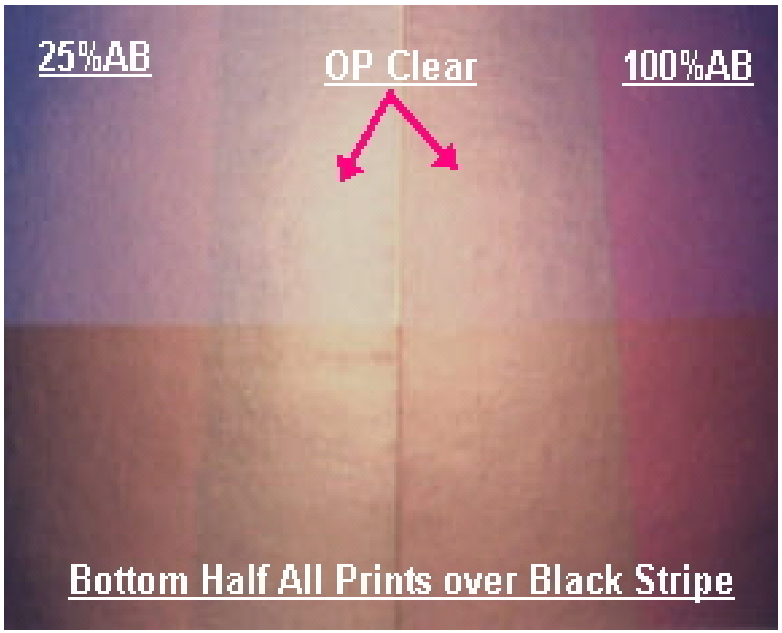
Reflex Blue PB-61 Print -Uncoated Stock



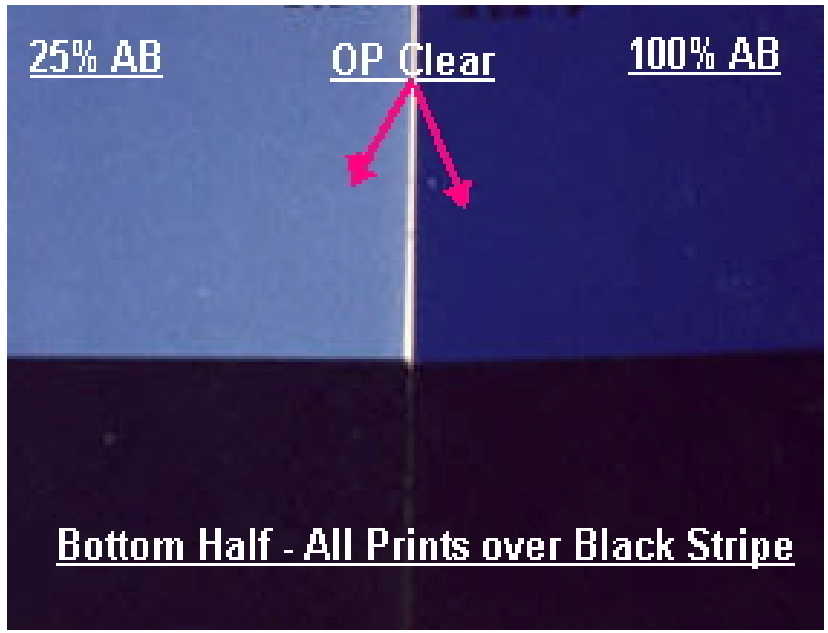
45/45 Viewing

90/45 Viewing

25% & 100% Alkali Blue - Coated Stock + OP Varnish



45/45 Viewing



90/45 Viewing

Warm Red PR-52.1 Print - Coated Stock

45/45 Viewing

90/45 Viewing

Pantone Prints Std. & Batch - Uncoated Stock

45/45 Viewing

90/45 Viewing

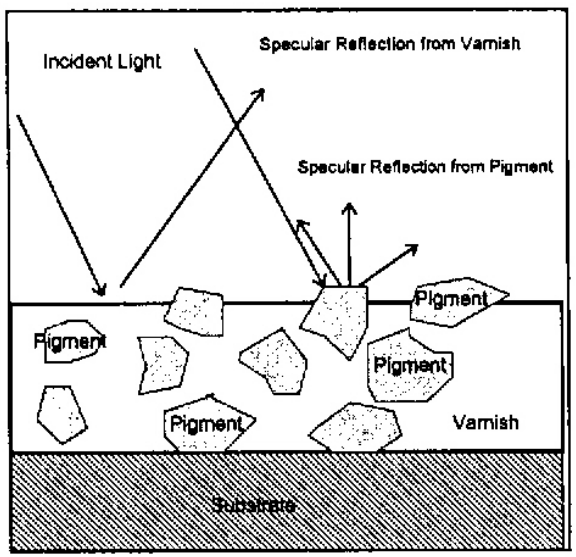
Causes of Bronzing

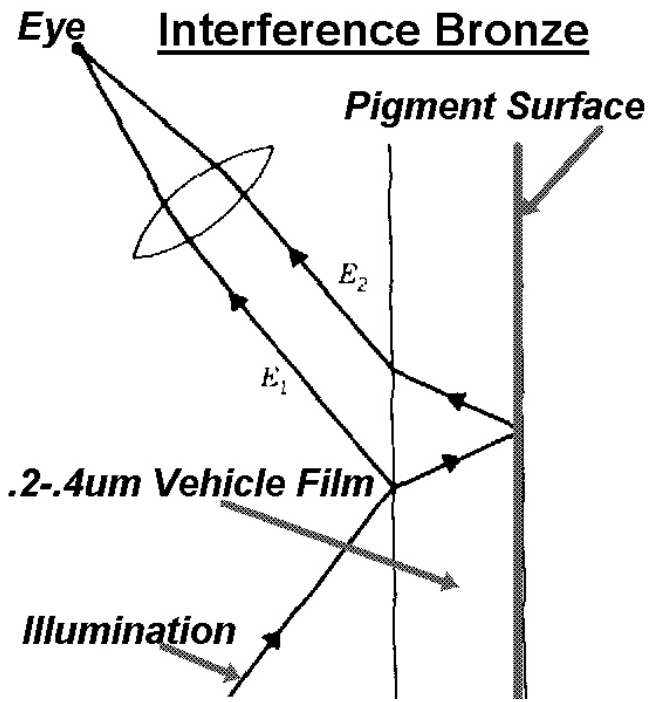
- ***Common theory says that at high loadings, pigment is in contact with air at the film surface producing a different diffuse reflectance.***
- ***This assumes that adsorbed vehicle flows completely off the pigment***
- ***If this did happen, then there should be no angular change in bronze hue***

Causes of Bronzing

- ***If, however, a thin film of vehicle remains on the pigment surface, then colors in the visible region can be caused by interference of light in the reflected beams, which will show changes in hue with angle of view.***
- ***The thickness(T) range for visible colors to show is: $T = n\lambda/2$, where n is an integer(1 for 1st order) & λ= Wavelength. Thus 0.2 to 0.35um films yield visible light***

Origin of Bronzing
Opposing Theories



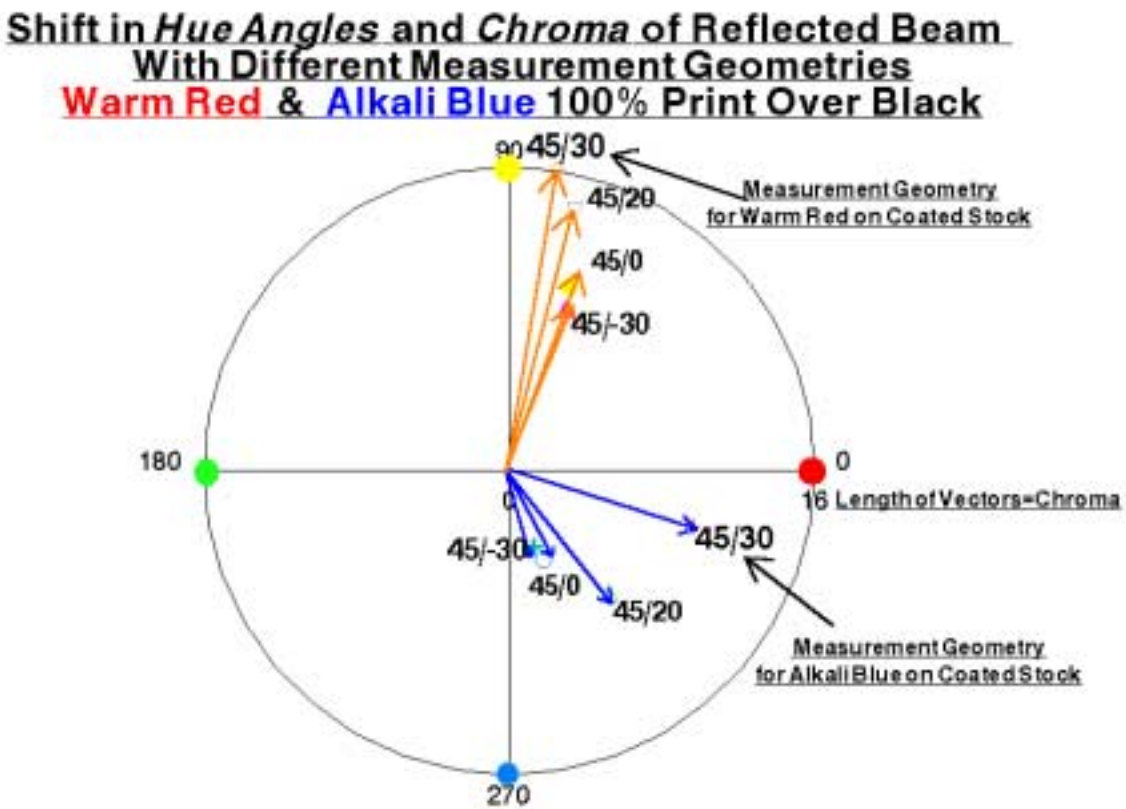


Current **Proposed**

Minimizing Bronzing

- ***In either case, thick films of varnish over the print tend to reduce or eliminate bronzing, by shifting the reflectance into the infrared region or by eliminating the supposed air pigment interface.***
- ***Reducing the concentration of bronzing pigments also lowers it.***

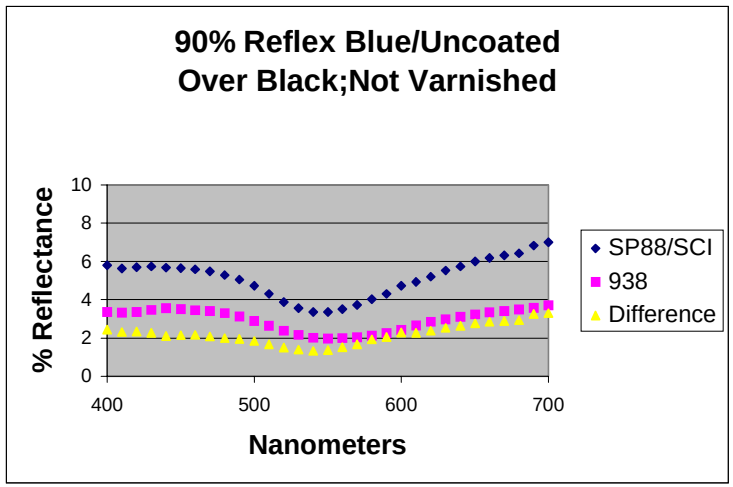
Change in Hue and Chroma of PB-56 & PR-52 as Reflected Beam ---> 45/45 (Specular Angle)

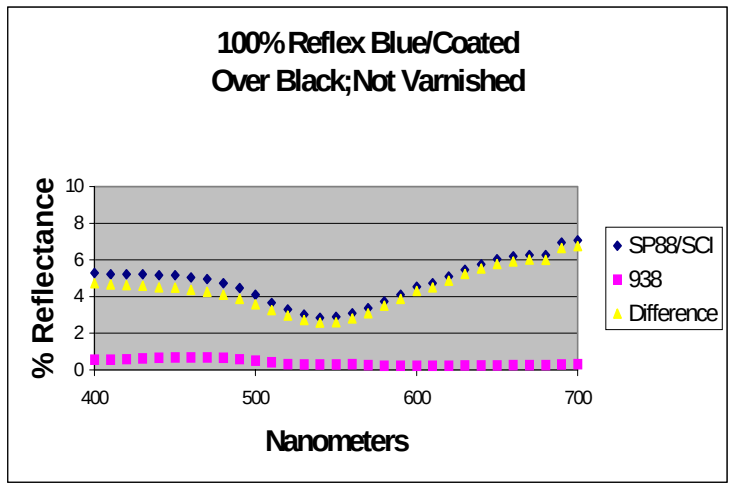


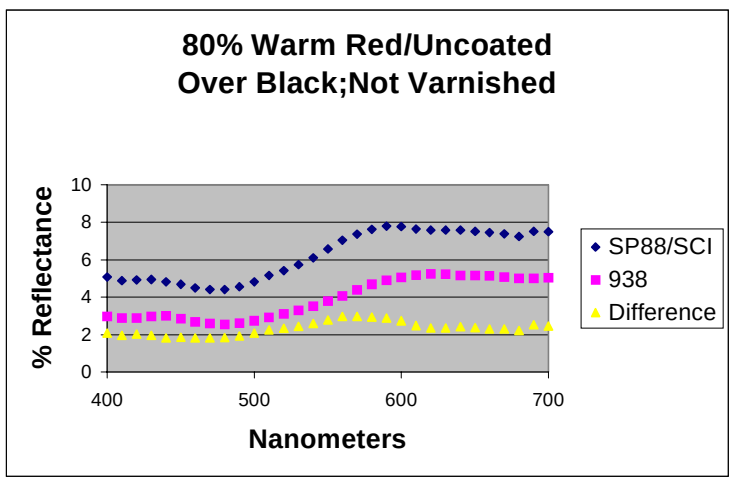
Measurement of Bronze

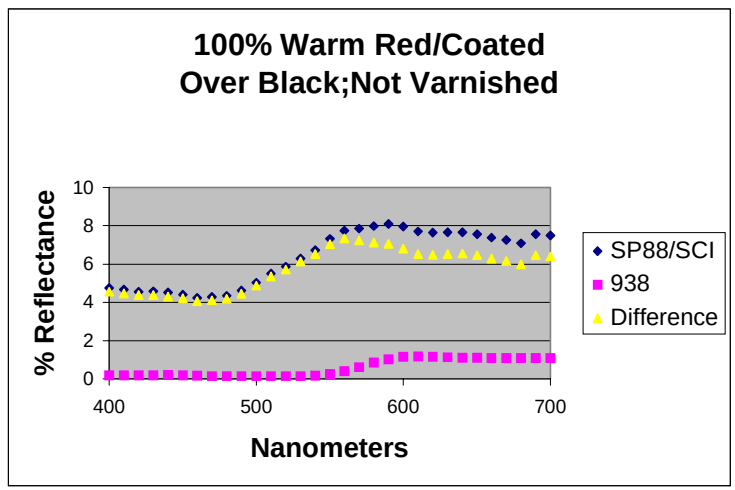
- ***One possible method measures the Delta E between a bronzy print and the same print overvarnished, using a spectrometer, specular included.***
- ***Another method, which eliminates overvarnishing, makes a difference spectral curve by subtracting the SPEX from the SPIN spectral curves.***

Difference Curves
SCI - SCE for Blue & Red Prints









Bronzing Studies Conclusions #1

- ***Bronzing is a phenomenon in which the appearance of a print of an ink made with certain pigments changes to an orange, metallic color when it is viewed at angles near the specular.***
- ***Since this occurs only when pigment levels are high, current theory says that pigment particles are pushed above the film and exposed to air.***

Bronzing Studies Conclusions #2

- ***However, if the pigment did have an air interface, the strong angular changes in hue observed here should not occur.***
- ***But the color of the bronze varies with the angle of viewing, even approaching the color of the non-bronzed film***

Bronzing Studies Conclusions #3

- ***Thick films of vehicle or overprint varnish will reduce/eliminate bronze***
- ***If the refractive index difference of the pigment and vehicle is small, bronzing disappears.***
- ***As angles of viewing approach the specular, the bronze gets more intense and shifts in hue.***

Bronzing Studies Conclusions #4

- ***The current model of the cause of Bronzing is not supported by the measurements or the data obtained.***
- ***It is suggested that the presence of a layer of vehicle on the pigment particles of about 0.2 - 0.35 um can cause interference colors in the light reflected at near the specular angle.***

Bronzing Studies Conclusions #5

- ***Delta E of color measurements of a bronzed print and a section of the print overcoated with a clear varnish are proportional to observed bronze.***
- ***Difference curves between specular included and excluded are also indicative of the color, hue and intensity of the observed bronze.***