FERRO
Where innovation delivers performance™

Technical Information

DF 20

Performance Colors & Glass

CerDeChrom*Advanz*
Ceramic Color Management System

Today it is no longer necessary to compromise to obtain top results in ceramic printing. The additional colors and hand corrections required by the four-color process are a thing of the past.

With the **CerDeChrom*Advanz*** Ceramic Color Management System, it is now possible for the first time to create the entire color spectrum in one process.

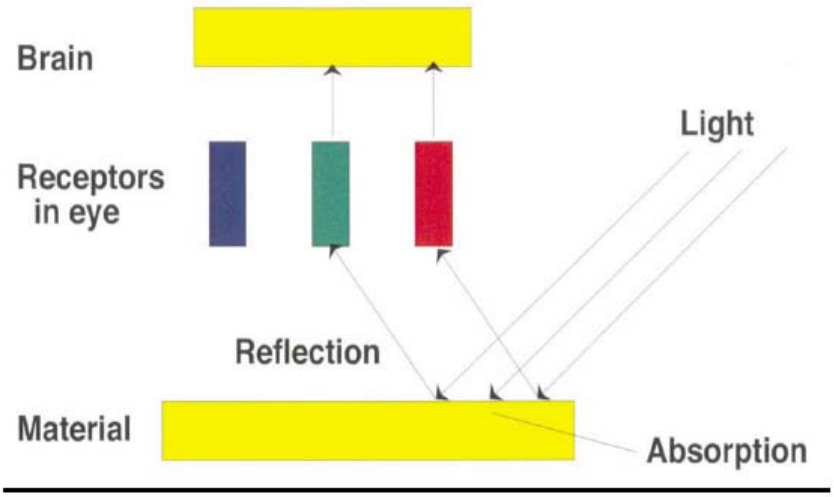
This revolutionary development in ceramic decoration has been made possible by the combination of novel software and specialised new decorating colors from Cerdec.

The **CerDeChrom*Advanz*** Ceramic Color Management System gives accurate reproduction with brilliant color definition and optimal resistance.

Contents

1. Basic principles

The retina of the human eye has three types of receptors (cones) that react to differing forms of radiation: short-, medium- and long-wave. When the receptors are excited by radiation, the nervous system relays the information to the brain, where it is registered as a color sensation.



This results in the perception of eight different colors based on the varying activation of the three receptors.

Primary Colours	B	G	R
W	1	1	1
Y	0	1	1
M	1	0	1
C	1	1	0
B	1	0	0
G	0	1	0
R	0	0	1
B	0	0	0

In modern color theory, these eight colors are defined as the basic, or primary, colors. Optimal color reproduction is only possible with all eight primary colors.

Traditional four-color printing, however, is based on subtractive color mixtures of only three primary colors (yellow, magenta and cyan) and black. The three remaining chromatic primary colors (green, blue-violet and red-orange) are produced by combinations of the first three.

Standardization of four-color printing inks (Euroscale / EN 16 538/539) in Europe has rendered the application of this technology to graphic printing much easier, and normal European practice in ceramic printing is also to use chromatic components in accordance with the Euroscale.

2. Traditional four-color printing with ceramic colors

After Cerdec developed colors and thixotropic media for four-color ceramic printing, this technology developed rapidly and in some market sectors, such as collector's plates, four-color printing is now the established standard.

One difficulty with four-color ceramic printing, however, is that the three chromatic colors (yellow, magenta and cyan) do not correspond to the Euroscale in intensity and purity. This means that the original and its reproduction can differ considerably, requiring significant correction. Even experienced printers need to run three to four proofs before achieving an acceptable reproduction.

”Clown” plate in **four-color printing**
(traditional chromatic components based on Euroscale)

2.1 Optimized four-color printing with CerDeChrom*Advanz*

In co-operation with Color Solutions, Inc. USA and Type Maker UK, a new chromatic component system **(CerDeChrom*Advanz* I)** has been developed for ceramics that is precisely geared to the new, optimized four-color printing from Ferro. The system takes into account the peculiarities of ceramic colors and consequently its results are much truer to the originals.

”Clown” plate in **four-color-printing**
(chromatic components based on **CerDeChrom*Advanz***)

2.2 Use of additional spot colors on ceramics

Creating pure and brilliant colors in the red-orange, green and blue-violet ranges is difficult enough using the organic colors in the Euroscale: The sacrifices in quality demanded by ceramic four-color printing are even more pronounced.

For this reason, many ceramic decors are done with so-called ”pick“ or ”spot“ colors. In this process decoration elements considered color-critical are omitted from the chromatic coloring process and later filled in by the use of additional colors, red-orange, green and blue-violet being the most common. Corrections must be carried out by an experienced lithographer.

3. Seven-color printing with ceramic colors

Seven-color printing is a logical approach to optimizing reproduction of the entire color spectrum. Until recently, production of the chromatic components was both technically limited and expensive, but software combined with a newly developed seven-color series from Ferro **(CerDeChrom*Advanz* II)** has now made it possible to create top-quality reproductions economically.

The method is not based on empirical principles, i.e. years of experience by a lithographer, but rather on colorimetrics and corresponding computer algorithms.

Ferro made a series of test prints with thousands of color fields in various mixing ratios of the seven printing colors (so-called Color Targets). A spectrophotometer was used for colorimetric measurement of these fields.

The resulting data transferred fully automatically to the color management software **CerDeChrom*Advanz***, which produces a printing profile. This printing profile contains both the printable range of colors and the formulae for separation into the seven printing colors.

CerDeChrom*Advanz* Edit makes it possible to show the printing results on a computer monitor – also colorimetrically calibrated. Creative changes are possible with an exact preview of printing results, even before the profiles are used. Actual separation into seven printing colors is fully automatic when profiles are used in the **CerDeChrom*Advanz*** Edit format.

The chromatic components can then be transferred onto film with any PostScript developer and the color image is composed by conventional means, using chromatic mixtures.

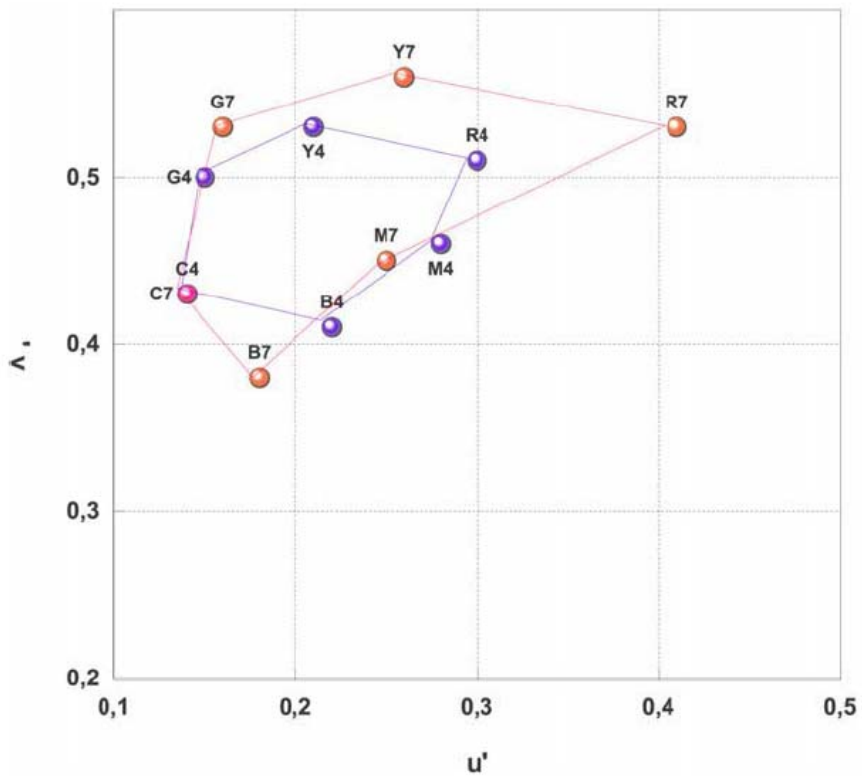
”Clown” plate in **seven-color-printing**
(chromatic components based on **CerDeChrom*Advanz***)

3.1 The gamut

Seven-color printing results in greatly improved color reproduction as compared with classic four-color printing.

In ceramic four-color printing, the reproducible gamut is limited by the pigment types available. The following diagram shows as an example in simplified form the gamut of ceramic onglaze colors reproducible with four- and seven-color printing. The presentation using the u' - v' system is particularly clear. The u' and v' values can be calculated on the basis of measured X, Y, Z values.

The gamut



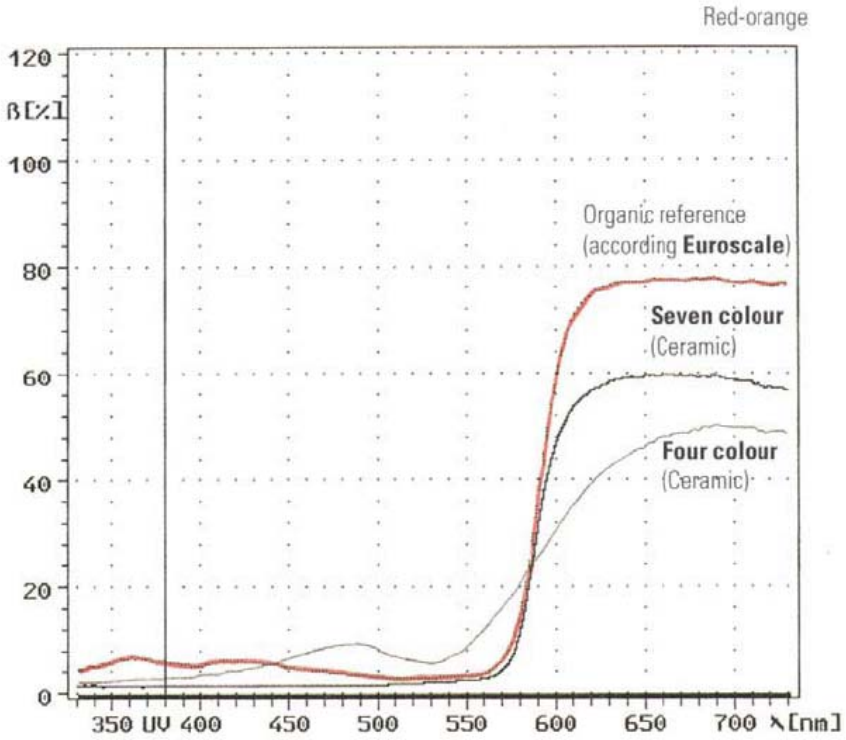
in **four-color printing** (Y4, M4, C4, R4, G4, B4)
and **seven-color printing** (Y7, M7, C7, R7, G7, B7)

The secondary colors red-orange, green and blue-violet are produced by combining the primary colors yellow, magenta and cyan. When the remission curves of these colors are compared with the theoretical values, the deviations are considerable.

In seven-color printing, however, the colors red-orange, green and blue-violet are used as primary colors. Remission curves are much closer to the theoretical values. The resulting color range is therefore much broader, and purer color tones can be produced.

The remission curves demonstrate the improved reproduction of the color red-orange using seven-color printing. The colors green and blue-violet are similarly improved, as are tertiary colors.

Diagram: "Spectral radiance factor ß[%] (P) - (B)



(Remission curves for red-orange in ceramic four- and seven-color printing compared with the organic hue)

3.2 Moiré

Avoidance of a moiré effect is no longer difficult using achromatic mixture in seven-color printing made possible by scanners (UCR setting). Each chromatic tone is represented by a color from Group I -yellow, magenta, cyan and a color from Group II - red-orange, green, blue-violet. The colors from Group I are at one angle and those of Group II at another. Angling is recommended as follows:

15° or 105° yellow
15° or 105° magenta
15° or 105° cyan
75° or 165° red-orange
75° or 165° green
75° or 165° blue-violet
45° black

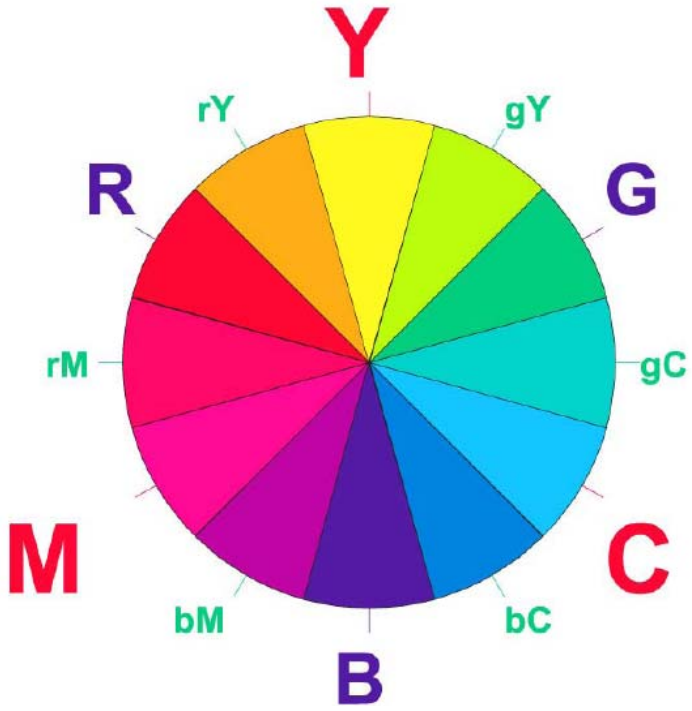
Black is angled separately as the achromatic supplementary color for depth of focus. Variations from the recommended angles will not have any negative impact to the color reproduction.

Ceramic serigraphy employs the conventional chromatic mixture method. Since in this method most chromatic tones are formed using a color from Group I and a neighbouring color from Group II, the same angling is recommended as for achromatic mixture.

3.3 Color tolerances

In seven-color printing, each color tone is created as a primary color with two neighbouring chromatic colors from the chromatic circle.

Chromatic circle



Group I colors: Y, M, C
Group II colors: R, G, B

Color variations, which can never be entirely eliminated, as well as variations in the reproduction process, have less of a disturbing influence in seven-color printing than in four-color printing.

3.4 Halftone screen and textile selection

Screen and textile selection are the same for seven- and four-color printing in this respect. 40-48 halftone dots / cm should be used for high-grade prints. Halftone link-dots have proved useful.

So-called frequency-modulated half tones, in which the point size remains constant, are new to ceramics. Coverage is controlled by the number of points per unit of area. Especially when used for low coverage (5-10%), this type of halftone screen offers considerable advantages over conventional halftone screens, since the points must not be smaller than the critical size of approx. 90 µm. Both polyester textile (120-150 threads/cm / 305-380 mesh/inch) and comparable steel textiles are suitable. There are specific advantages and drawbacks of these two types - open mesh surface, durability, electrostatics, price, etc., however, not mentioned here in detail.

4. Ceramic colors for seven-color printing

Ceramic colors must fulfil the following conditions for seven-color printing:

1. Mutual compatibility of colors
2. Approximation of color loci to theoretical values
3. Minimum lead and cadmium release
4. Good dishwasher resistance
5. Compatibility with flux coating
6. Good printability

The first two requirements in particular make it necessary to work with pigments different from those used in four-color printing in some cases.

Cadmium pigments are the ideal choice for creating red-orange and yellow colors, but they are known to exhibit firing instability. For this reason, types with particularly good firing stability have been selected and combined with special screen printing media in order to facilitate thicker color layer with good halftone quality.

New colors have been developed in the green and magenta ranges to achieve optimal firing stability and color development in combination with red-orange and yellow cadmium pigments. Paste viscosity should be between 4 and 8 Pa*s, depending on printing speed. Screen printing oils with very high color absorption levels are recommended for cadmium colors.

5. System details

Whilst Ferro sells the ceramic colors for **CerDeChrom*Advanz***, the sales, installation and maintenance of the CerDeChrom*Advanz* software is handled exclusively by TypeMaker Ltd., U.K.

CerDeChrom*Advanz* is an application and work-flow that runs on the Power Macintosh computing platform. It allows automated 4- and 7-color separations to be produced, with the option of soft-proofing to screen and a digital proof printer, such as an inkjet or laser printer/copier.

CerDeChrom*Advanz* is developed around the industry standard ICC profiling system and is compatible with all common pre-press applications software, including Adobe PhotoShop, PlateScribe, Quark Xpress and EPS-Layout.

5.1 Hardware requirements

A check-list is given out to compare a customer's existing pre-press equipment with the minimum requirements to implement ***CerDeChromAdvanz***. Any client considering purchasing additional equipment should seek TypeMaker's assistance to verify that the items will be suitable for use with the system. A complete recommendation for installing a new system will also be available on request.

5.2 Work-flow

1) The original image is scanned on a drum or flatbed scanner into an RGB TIFF file.

2) **CerDeChrom*Advanz*** Edit application is used to view on screen the original RGB scanned artwork and a color- correct representation of the **CerDeChrom*Advanz*** 4- or 7-color process.

3) If necessary, color corrections and edits can then be applied within the correct ceramic colorspace.

4) **CerDeChrom*Advanz*** Edit application can optionally be used to print a digital proof image, simulating the ceramic separations.

5) **CerDeChrom*Advanz*** Edit application is used to view and then make the separations which can be made up into a layout and sent to an imagesetter or plotter for output.

CerDeChrom*Advanz* Edit offers a wide range of color correction and editing tools which can be applied manually to individual images or automatically as a batch procedure.

These include as an example:

- automatic or interactive settings of highlights and shadows
- adjustment of lightness, contrast and saturation
- selective color correction
- global tone adjustments of primary colors in lightness, chroma and hue angle

All corrections are applied within the relevant 4- or 7-color ceramic colorspace.

5.3 Installation process

Once a customer has used the **CerDeChrom*Advanz*** test procedure to validate that they are able to attain the necessary printing conditions and control to use the **CerDeChrom*Advanz*** package, it is necessary for an installation of the software to take place, along with the profiling of the customer's local devices.

Scanner profile - on installation, TypeMaker will profile the customer's scanner(s) by using an industry standard IT8 target and the **CerDeChrom*Advanz*** Profiling application. Once the scanner is profiled, scans must always be made to the same settings and if the scanner is changed or the software driving it updated, it will be necessary to create a new profile.

Monitor profile – where an on-screen simulated representation of the final fired image is required, it is necessary to produce an optimized profile of the display. Firstly it is necessary to have a good quality computer monitor that is in a stable lighting condition. In theory any monitor can be calibrated but in practice this is not so. Older monitors are inherently unstable and sometimes it is better to consider the purchase of a high-end calibrated monitor if this part of the **CerDeChrom*Advanz*** system is critical.

Proof printer profile - any color printer can be profiled to show an accurate proof of the final result but the accuracy of the color match will be dependent on the customer's printer and its capabilities. Good results will be possible from modern high-end inkjet printers, as well as dye-sublimation printers and some color copiers.

TypeMaker will maintain a list of recommended monitors and printers for customers considering new purchases and will be happy to give their advice on the suitability of your existing equipment.

If a customer uses external service bureaus for scanning or proofing, it is necessary to profile these devices and ensure that the service provider can guarantee to maintain their equipment to the same specification as at the time the initial profiles are taken. Again, it will be necessary to re-profile any devices that change or are upgraded. A good monitor and monitor display profile is an advantage to be able to review the scanned artwork supplied by the external supplier.

5.4 Training

All **CerDeChrom*Advanz*** systems will be installed on-site by an experienced TypeMaker technician who will be able to ensure that the client's pre-press operators are confident in using the system.

5.5 Maintaining the CerDeChromAdvanz system

CerDeChrom*Advanz* has the same requirements as any existing separation system which means that consistency needs to be maintained from the linearisation of the imagesetter through to the presses, in exactly the same way as it is with traditional systems.

However **CerDeChrom*Advanz*** Edit allows the customer to make changes to the way separations are made to allow for fluctuations in the local printing environment. Installation of the **CerDeChrom*Advanz*** system includes training on these functions to allow a customer to become self-sufficient, although TypeMaker will always be on-hand to provide ongoing support when required.

The **CerDeChrom*Advanz*** system will be continually enhanced to cover additional application fields. Also improvements of the software, the colors or the media will lead to new updates to the benefit of our customers so that all **CerDeChrom*Advanz*** users are always at the latest state of the art. These updates will be made available to customers as they are released as part of an ongoing software maintenance and update package.

6. Summary

Seven-color printing makes possible a spectrum of colors that cannot be achieved with traditional four-color printing. This is particularly true for ceramics. Furthermore, seven-color printing requires less reprotechnical work than the 4-color method, which often requires additional spot colors.

This revolutionary printing method was made possible by the symbiotic development of **CerDeChrom*Advanz*** Ceramic Color Management System and special ceramic colors.

CerDeChrom*Advanz* is, of course, primarily interesting for all printers who already employ the 4-color-print (e.g. for collector plates). However, **CerDeChrom*Advanz*** is not at all limited to this application. The standardization of this process also makes the use of **CerDeChrom*Advanz*** for dinnerware patterns attractive.

The hardware and software required is now affordable for small printing operations, and recoups its costs within a short period.

Four-color ceramic printing was initially developed for decal printing. Direct printing thereafter became more common as expertise increased and today, various eight-color machines are available, so that conversion to seven-color printing poses no mechanical problems.

References

(1) Harald Küppers: *"Warum Siebenfarbendruc*k" [Der Fadenzähler]
Gebr. Schmidt Druckfarben, Frankfurt am Main, 1991

(2) Eric Wagg und Hans Hilgenfeld: *"Screen Printin*g",
Cerdec Corp.-Drakenfeld Products, Washington, PA, 1995