Improving Print Standards by Specifying Isometric Tone Reproduction for the Overall Process

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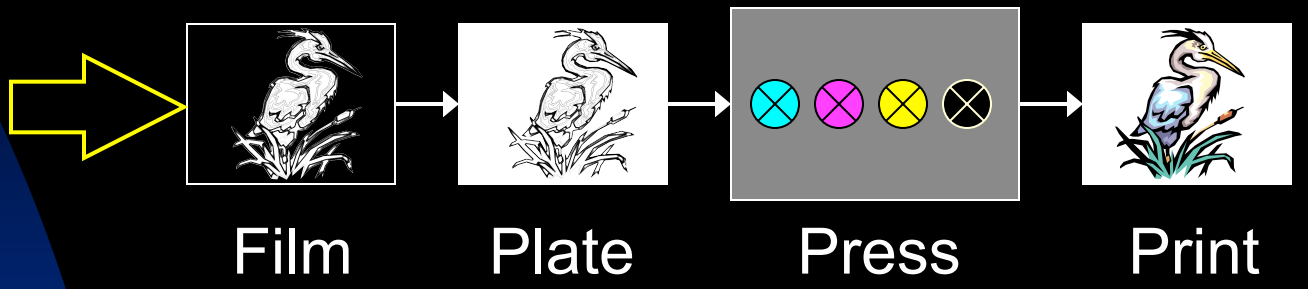
TAGA Annual Technical Conference
San Antonio, TX
April 20, 2004

Main Topics

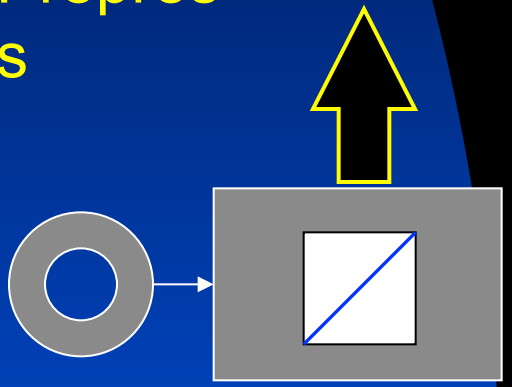
- Discussion of Existing **Print Standards.**
- Our Experimental Work **Matching** Press Sheets using TRCs.
- **Recommendations** for Improving Print Standards.

Film Based Process



Press

Prepress

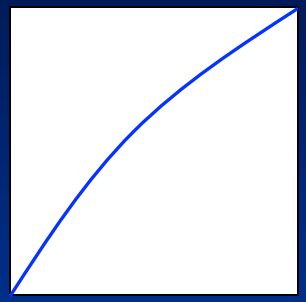


- Input: Film
- Output: Print
- Controls: Press/Inking

CtP Process

- Input: File
- Output: Print
- Controls: TRCs, Press/Inking

Calibration - The Foundation of Color Management



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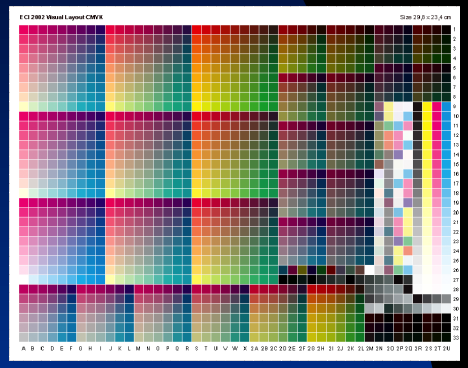
- How Do We **Compute TRCs** for Proofing and Platemaking?
- Existing Standards Don’t Provide the **Target Data** We Need!

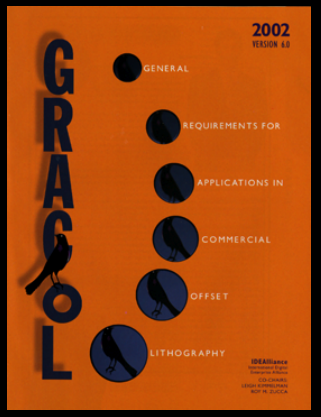
How to Create a Useful Standard

- Determine **What** Needs to be Controlled.
- Specify the **Ideal Result** as Exactly as Possible.
- Specify the **Allowable Deviation** from the Ideal.

Information Describing the Printing Process



ECI2002 Target
1485 x 3 =
4455 Values



GRACoL
5 x 3 +
4 TVI +
4 PC =
23 Values

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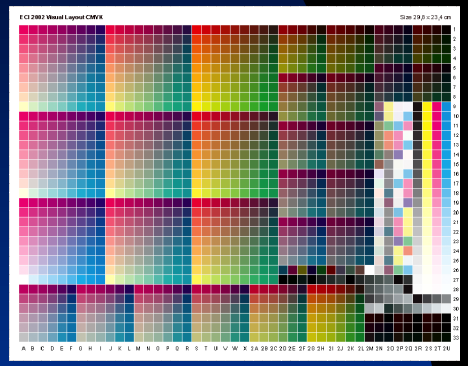

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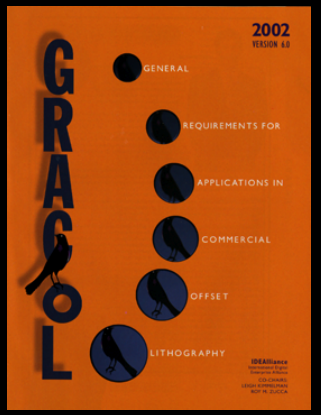
What Info is Really Needed to Calibrate a Press?



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Checklist of Printing Control Parameters

- Paper (Raw Materials)
- Inks (Raw Materials)
- Solid Ink Density (Press)
- Tone Reproduction (Platemaking and Press)
- Gray Balance (Platemaking and Press)

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- ? Gray Balance (Platemaking and Press)

Tone Reproduction Specifications

- Relationship Between % Dot and Printed Tone Value.
- GRACoL Specifies 50% TVI and Print Contrast.
- ISO 12647-2:2003+ Specifies Complete TVI Curves.
- Measurements Are Based on Densitometry.

Tone Reproduction Specifications

- Relationship Between % Dot and Printed Tone Value.
- GRACoL Specifies 50% TVI and

the print buyer are spelled out so that they can work together with a

and additionally deals with new trends in the industry that may or

as the reference through each step in the process? And how can print-

they show detail and how close they come to reproducing all the

INPUT VARIABLES			OUTPUT VARIABLES											
PAPER/ SUBSTRATE	LINE SCREEN	TAC	SOLID INK DENSITY				TVI				PRINT CONTRAST			
			K	C	M	Y	K	C	M	Y	K	C	M	Y
Grades #1 & #2														
Premium Gloss Dull/Coated	175	320%	1.70	1.40	1.50	1.05	22	20	20	18	40-45	35-40	35-40	30-35
Grades #1 and #2														
Premium matte coated	150-175	300-320%	1.60	1.30	1.40	1.00	24	22	22	20	40-45	35-40	35-40	30-35
Premium Text and Cover (smooth)	150-175	260%	1.30	1.15	1.15	0.90	26	22	22	20	35-45	30-40	30-40	25-35
Grade # 3	150	310%	1.65	1.35	1.45	1.02	22	21	22	18	45	40	40	35
Grade # 5 **	133	300%	1.60	1.30	1.40	1.00	22	20	20	18	35-45	30-40	30-40	25-35
Supercal SCA+	133	280%	1.50	1.25	1.35	1.00	28	26	26	24	23	21	21	20
Supercal SCA	120	260-280%	1.40	1.15	1.20	0.95	28	26	26	24	23	21	21	20
Supercal SCB	120	240-260%	1.35	1.10	1.15	0.95	28	26	26	24	23	21	21	20
Uncoated	110	240-260%	1.25	1.00	1.12	0.95	28	26	26	24	20	17	16	17
Newsprint***	85	240%	1.05	0.90	0.90	0.85	30	30	30	30	16	13	12	15
Newsprint (heatset) & Supercal SCC	100	240%	1.20	1.08	1.15	0.95	32	32	32	32	16	13	12	15

*Ink densities are dry. Dryback values are included. **Same as SWOP ***Same as SNAP

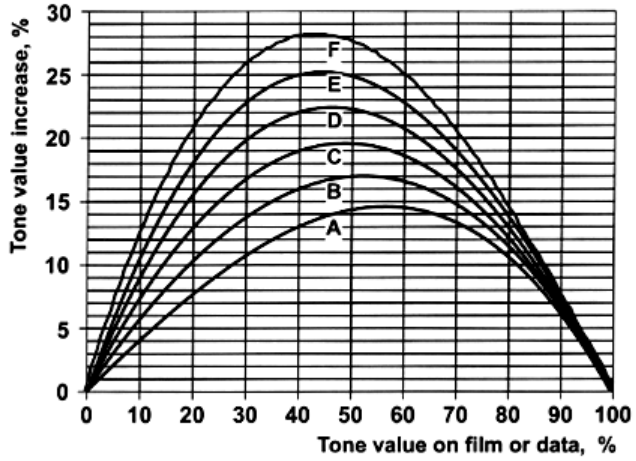

Figure 2 — Tone value increase curves for the printing conditions defined in Table 4. The letters A to F refer to printing conditions listed in Table 4.

4.3.5.2 Tolerances and mid-tone spread

The deviation of the mid-tone value increase of a proof or an OK print from the specified value shall not exceed the deviation tolerances specified in Table 5.

For production printing the average mid-tone value shall be within 4 % of the specified aim value. The statistical standard deviation of the tone values shall not exceed, and should not exceed one half of, the variation tolerance specified in Table 5.

The mid-tone spread (variation of tone values between chromatic colours) of proof and production printing shall not exceed the values listed in Table 5.

Table 5 — Tone value increase tolerances and maximum mid-tone spread for proof and production printing

percent

Tone value of control patch	Proof print deviation tolerance	OK print deviation tolerance	Production print variation tolerance
40 or 50	3	4	4
75 or 80	2	3	3
Maximum mid-tone spread	4	5	5

NOTE 1 It has to be recognized that in the worst case these tolerances may produce a difference between proof and OK print of 7 % in the mid-tone.

Reproduction ifications

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2647-2:2003+ Specifies lete TVI Curves.

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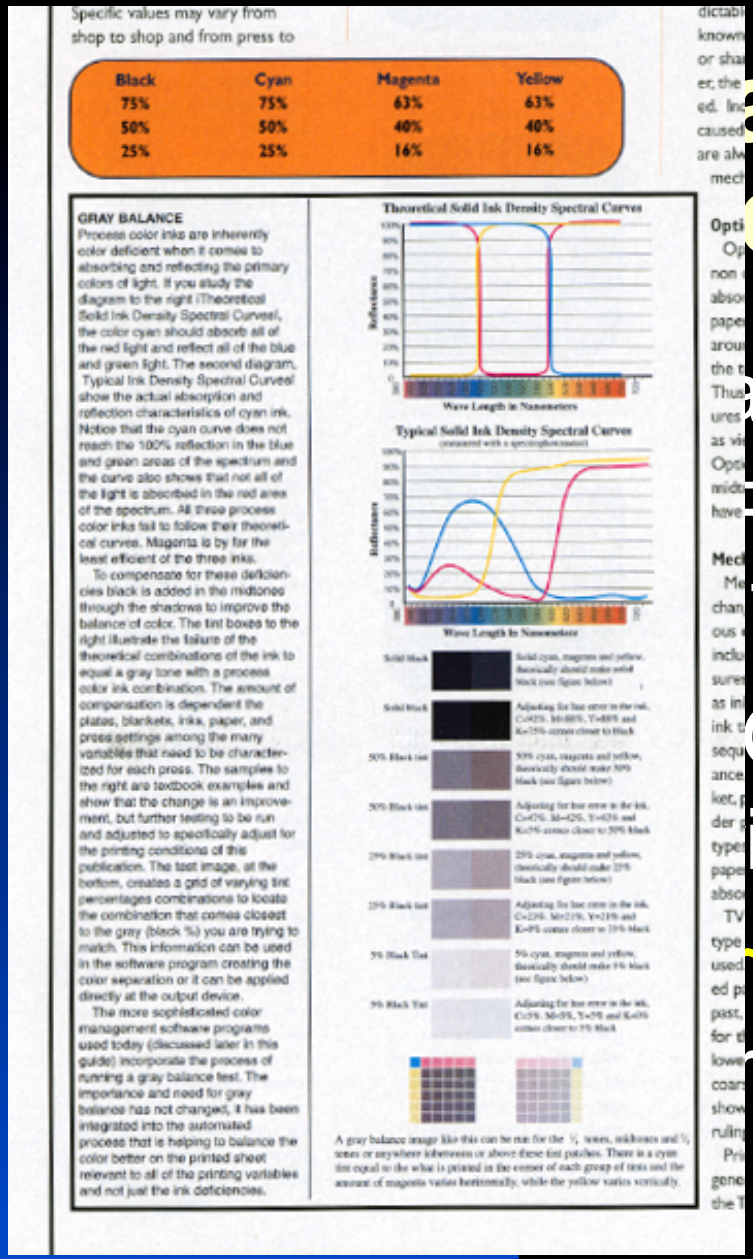
Gray Balance Specifications

- Balance of CMY Inks.
- GRACoL - Mentioned Briefly in Technical Supplement.
- ISO 12647-2 - Mentioned Briefly in Annex C.
- Gray Balance is Essential for Critical Color Matching!



Specific values may vary from shop to shop and from press to

Black	Cyan	Magenta	Yellow
75%	75%	63%	63%
50%	50%	40%	40%
25%	25%	16%	16%

GRAY BALANCE

Process color inks are inherently color deficient when it comes to absorbing and reflecting the primary colors of light. If you study the diagram to the right (Theoretical Solid Ink Density Spectral Curves), the color cyan should absorb all of the red light and reflect all of the blue and green light. The second diagram, Typical Ink Density Spectral Curves, show the actual absorption and reflection characteristics of cyan ink. Notice that the cyan curve does not reach the 100% reflection in the blue and green areas of the spectrum and the curve also shows that not all of the light is absorbed in the red area of the spectrum. All three process color inks fail to follow their theoretical curves. Magenta is by far the least efficient of the three inks.

To compensate for these deficiencies black is added in the midtones through the shadows to improve the balance of color. The tint boxes to the right illustrate the failure of the theoretical combinations of the ink to equal a gray tone with a process color ink combination. The amount of compensation is dependent the plates, blankets, inks, paper, and press settings among the many variables that need to be characterized for each press. The samples to the right are textbook examples and show that the change is an improvement, but further testing to be run and adjusted to specifically adjust for the printing conditions of this publication. The test image, at the bottom, creates a grid of varying tint percentages combinations to locate the combination that comes closest to the gray (black %) you are trying to match. This information can be used in the software program creating the color separation or it can be applied directly at the output device.

The more sophisticated color management software programs used today (discussed later in this guide) incorporate the process of running a gray balance test. The importance and need for gray balance has not changed, it has been integrated into the automated process that is helping to balance the color better on the printed sheet relevant to all of the printing variables and not just the ink deficiencies.

Theoretical Solid Ink Density Spectral Curves

Wave Length in Nanometers

Typical Solid Ink Density Spectral Curves

Wave Length in Nanometers

A gray balance image like this can be run for the ¼ tones, midtones and ¾ tones or anywhere inbetween or above these tint patches. There is a cyan tint equal to the what is printed in the corner of each group of tints and the amount of magenta varies horizontally, while the yellow varies vertically.

ay Balance ecifications

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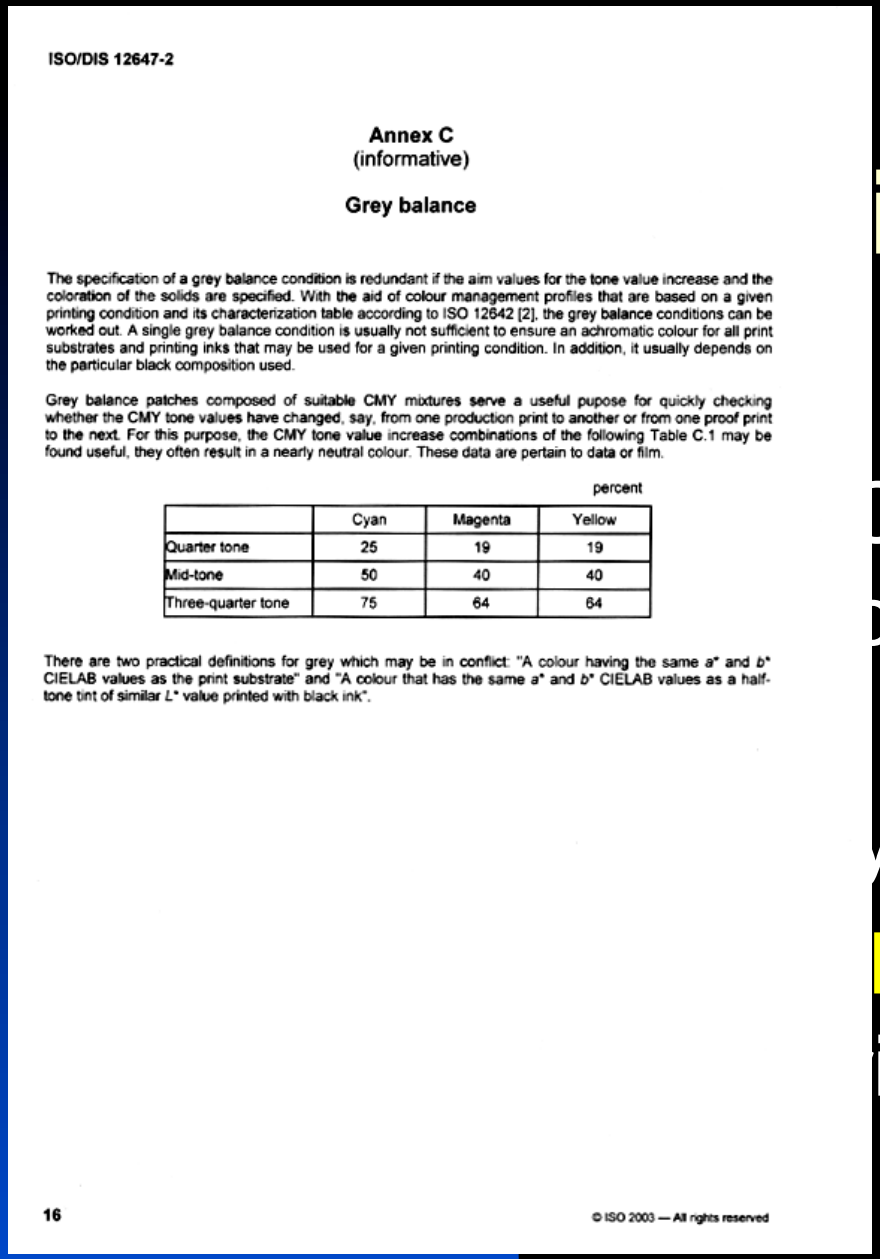


ISO/DIS 12647-2

Annex C
(informative)

Grey balance

The specification of a grey balance condition is redundant if the aim values for the tone value increase and the coloration of the solids are specified. With the aid of colour management profiles that are based on a given printing condition and its characterization table according to ISO 12642 [2], the grey balance conditions can be worked out. A single grey balance condition is usually not sufficient to ensure an achromatic colour for all print substrates and printing inks that may be used for a given printing condition. In addition, it usually depends on the particular black composition used.

Grey balance patches composed of suitable CMY mixtures serve a useful pupose for quickly checking whether the CMY tone values have changed, say, from one production print to another or from one proof print to the next. For this purpose, the CMY tone value increase combinations of the following Table C.1 may be found useful, they often result in a nearly neutral colour. These data are pertain to data or film.

percent

	Cyan	Magenta	Yellow
Quarter tone	25	19	19
Mid-tone	50	40	40
Three-quarter tone	75	64	64

There are two practical definitions for grey which may be in conflict: "A colour having the same *a** and *b** CIELAB values as the print substrate" and "A colour that has the same *a** and *b** CIELAB values as a half-tone tint of similar *L** value printed with black ink".

16

Balance ifications

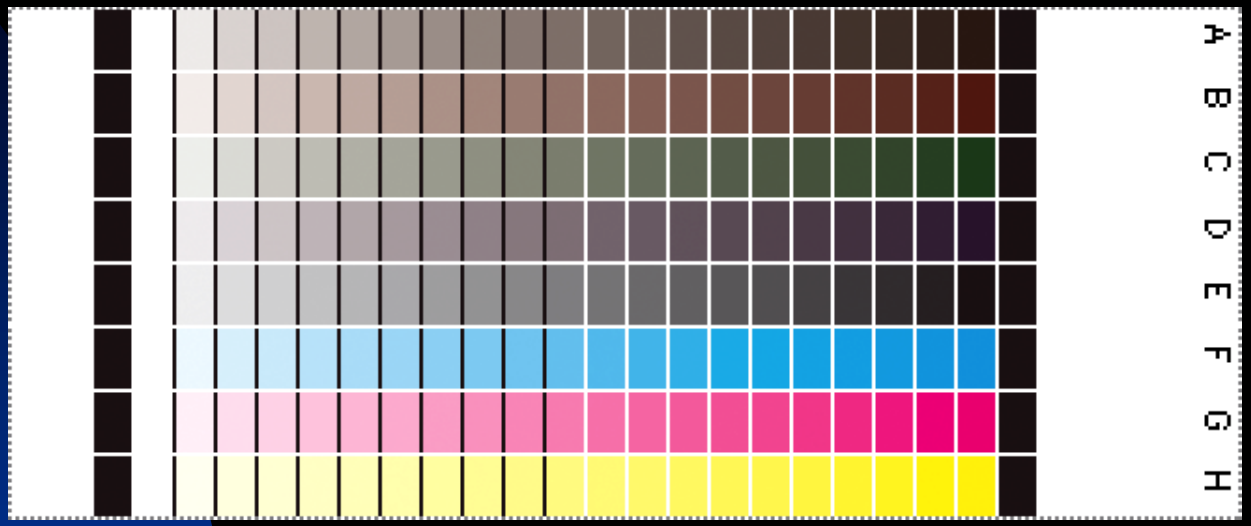
ce of CMY Inks.

CoL - Mentioned Briefly chnical Supplement.

2647-2 - Mentioned y in Annex C.

Balance is Essential itical Color Matching!

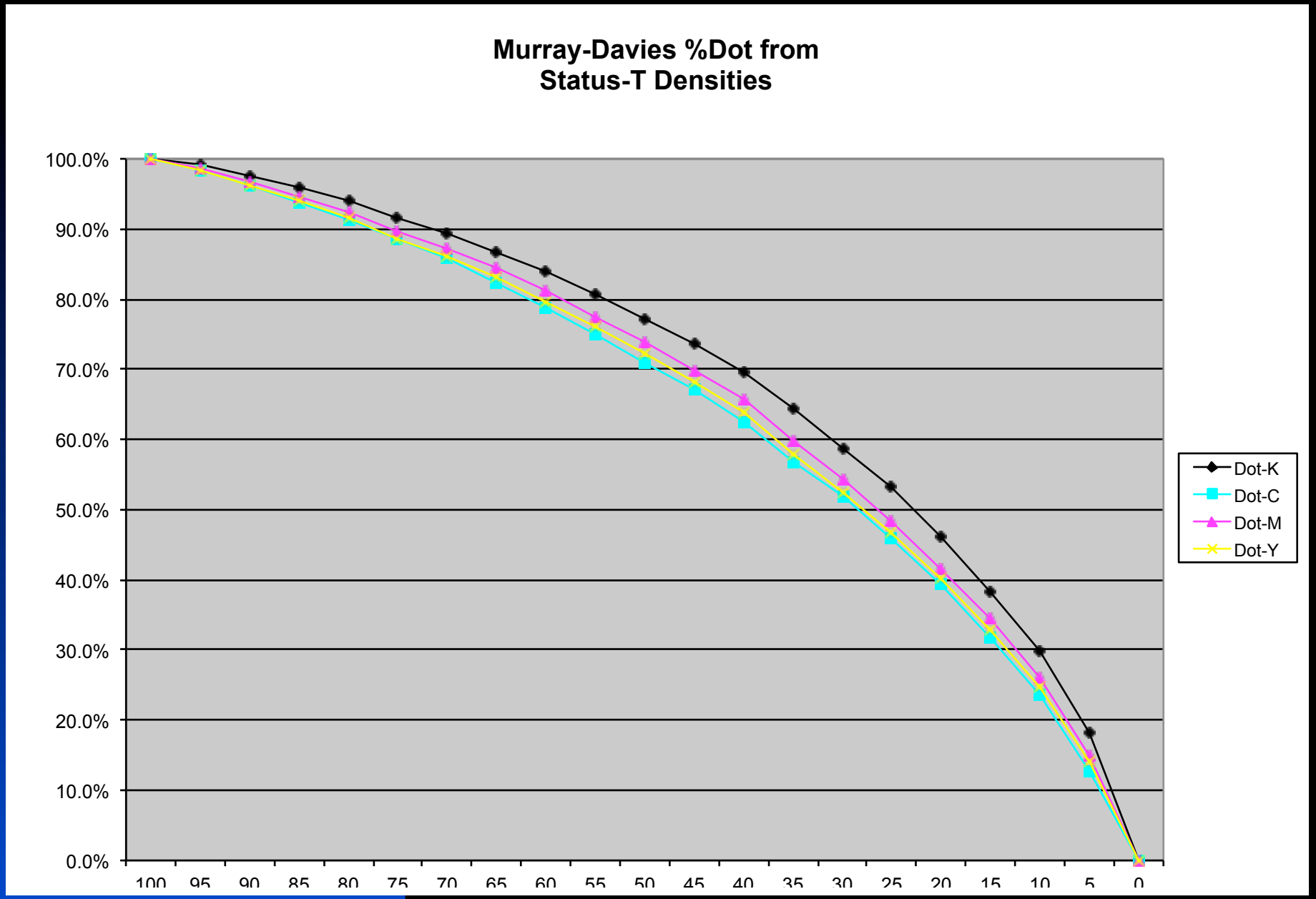
PressCal Target

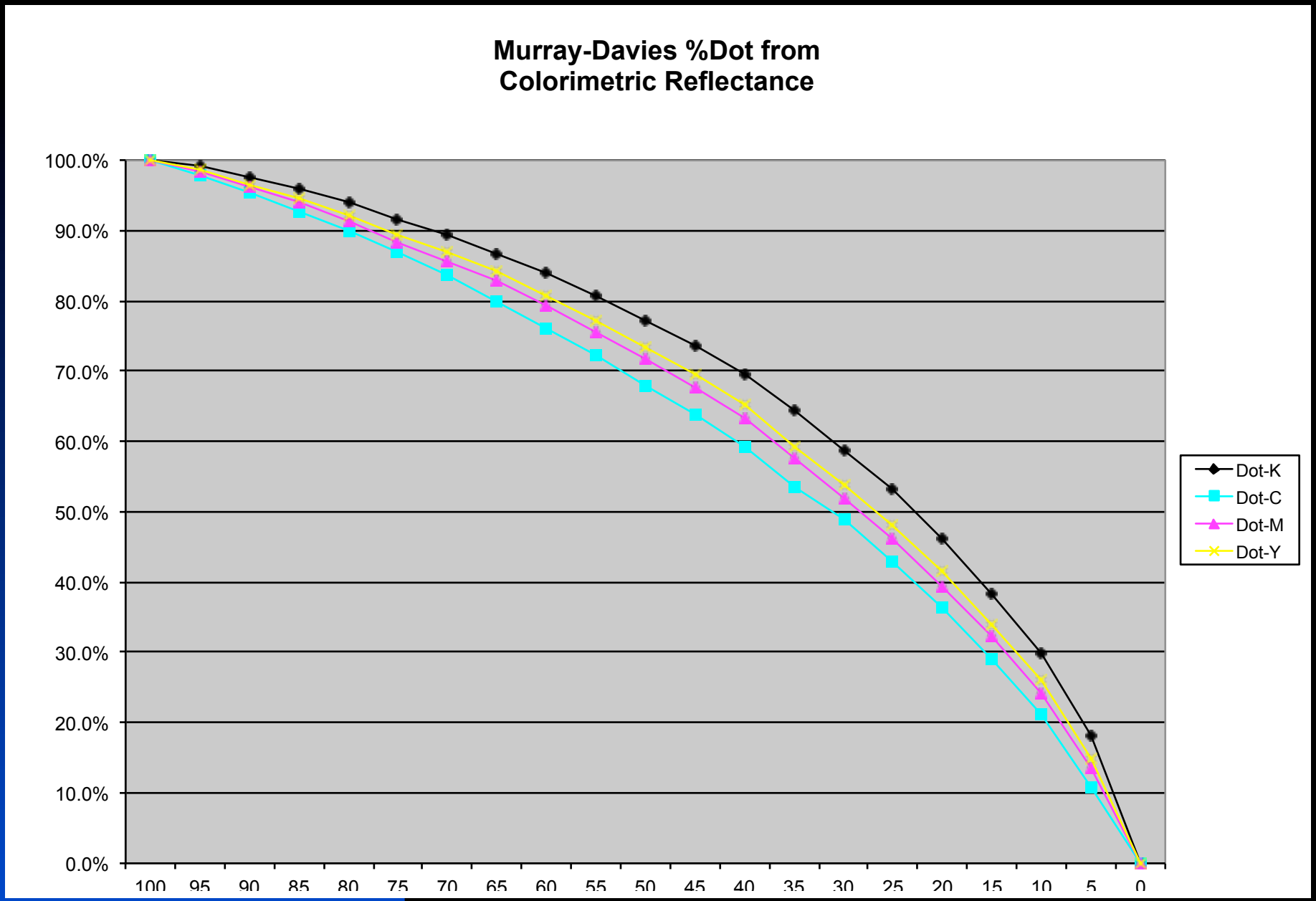


- A: Isometric Scale
- B-D: Interpolation Scales
- E-H: Pure Process Scales

Useful Results from Our Work

- TRCs Derived from **Colorimetric Data** Provide a Good Match.
- **Gray Balance** May Be Specified with Isometric Tone Curves.


Murray-Davies %Dot from
Status-T Densities
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Dot-K
Dot-C
Dot-M
Dot-Y


Murray-Davies %Dot from
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100.0%
90.0%
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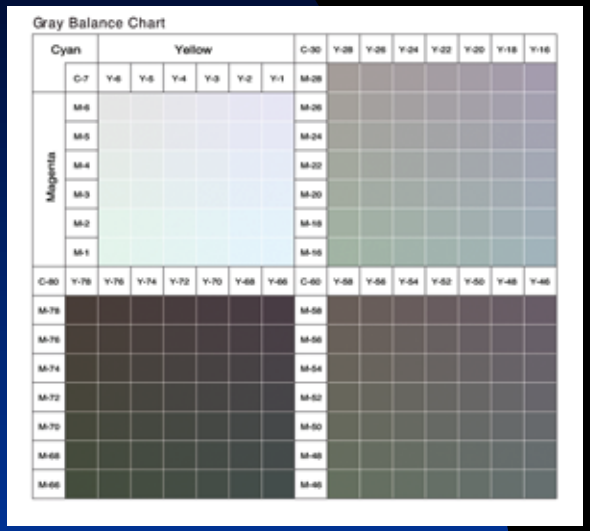
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Dot-K
Dot-C
Dot-M
Dot-Y

A New Way to Look at Gray Balance

- **Traditionally Specified as CMY** Values that Produce Gray (e.g. 50C, 40M, 40Y).
- Instead, Measure the Lab Value of an Isometric Patch (e.g. Lab = **51, 7, 3** @ 50C, 50M, 50Y).

A New Way to Look at Gray Balance



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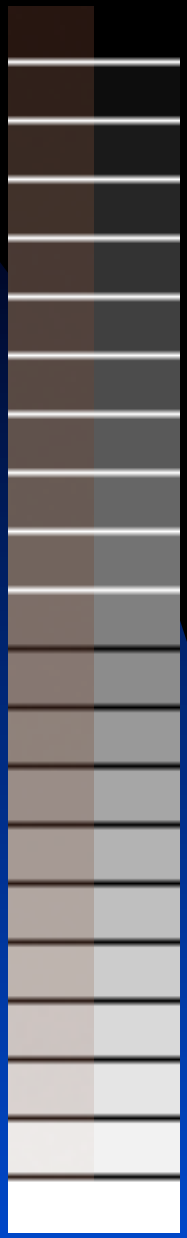
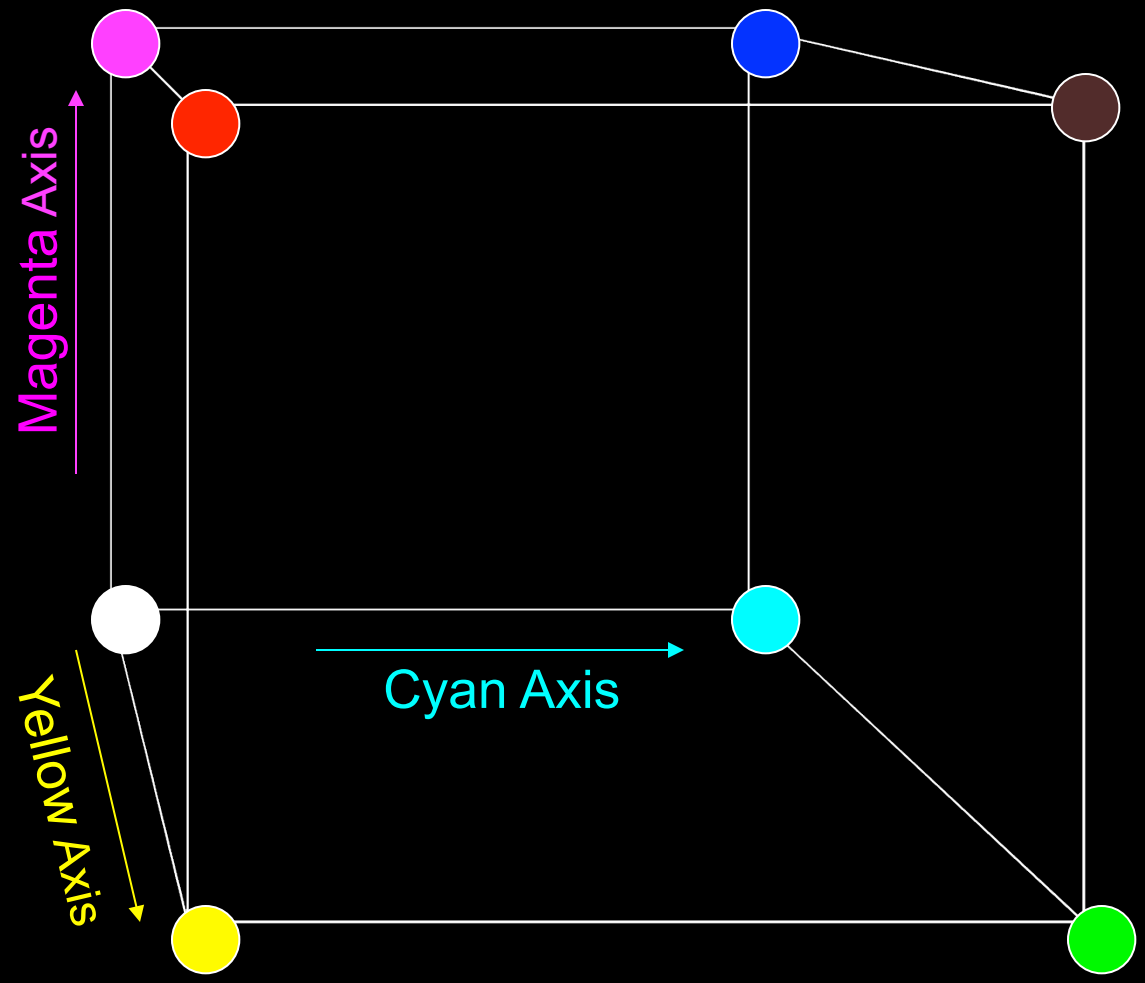


Isometric ≠ Gray

- Isometric Patches Are Not **Actually Gray**, But…
- Isometric Data Effectively **Specifies Gray Balance**.
- Simplifies Calculations.
- **Unifies** Print Standards with Color Management.

Isometric Axis (CMY Space)



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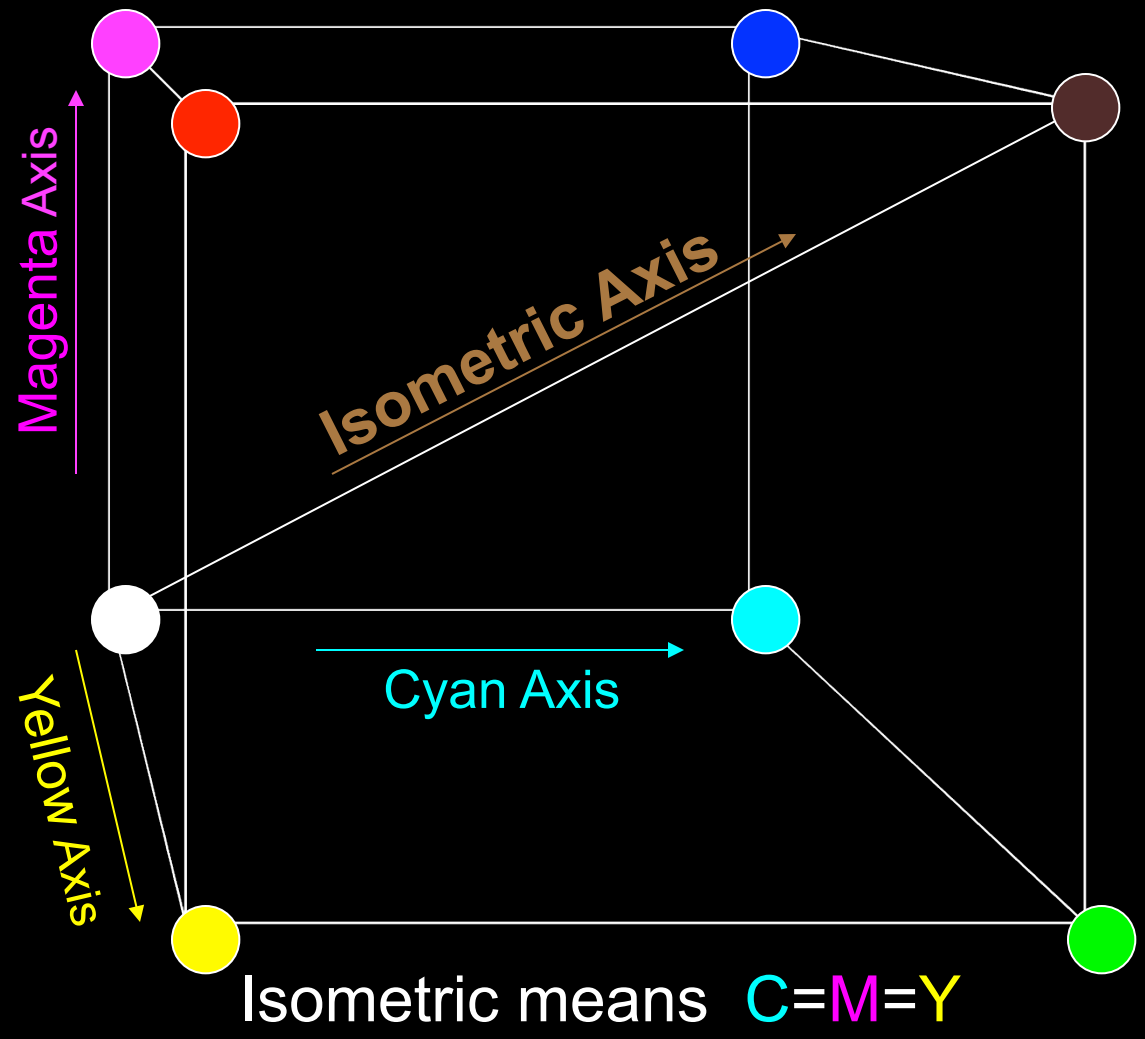
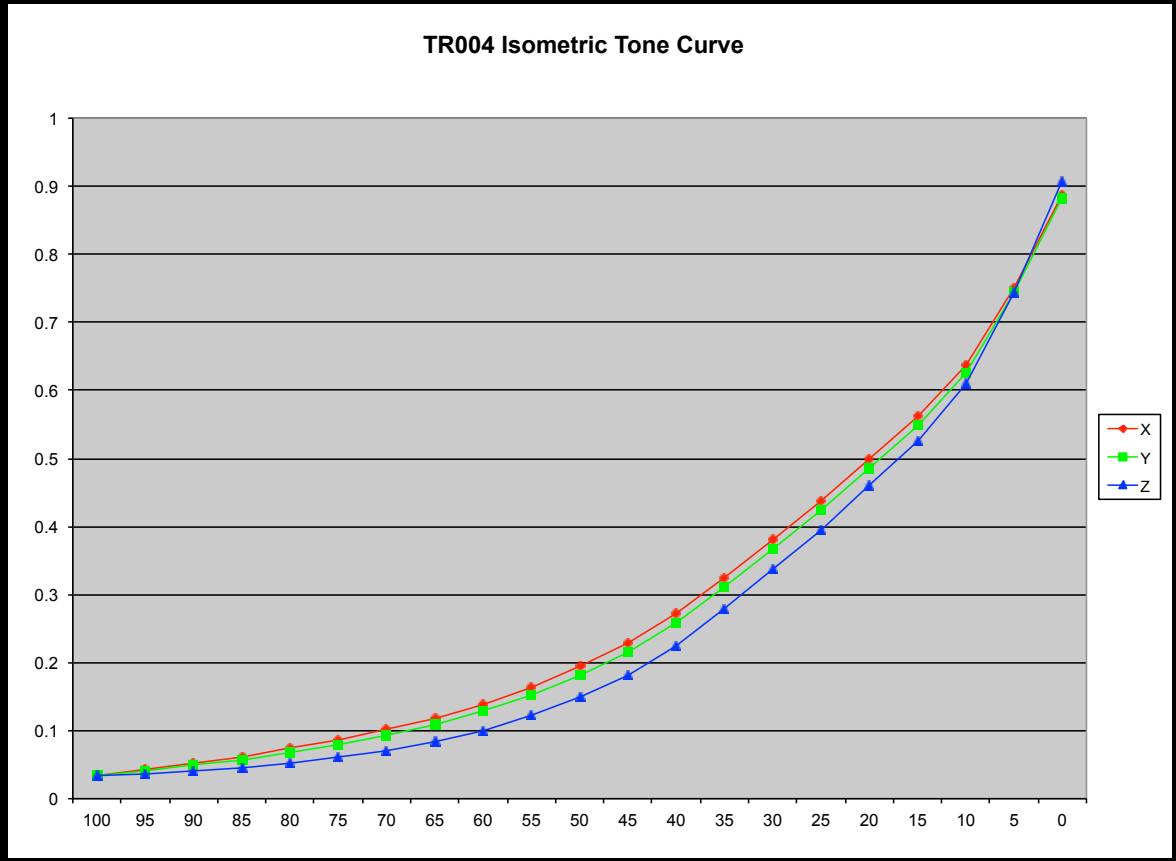


Isometric means C=M=Y

Isometric Tone Curve Example From TR004



Application to Print Standards

- Enlarge the Scope of Print Standards to **Include the Platemaking** Process.
- Provide Sufficient Information to **Calibrate the Overall Process.**
- Objective: Commercial Match **Without** Color Management!

Application to Print Standards

- Colorimetric Measurements Should Replace Density.
- Tone Reproduction Curves Should Replace TVI and Print Contrast.
- Calculation of TRCs Should Use Colorimetric Values.

Application to Print Standards

- Gray Balance Should Be Specified Using Isometric Tone Curves.
- All Tone Curves Should Be Specified as Formulas.
- Formulas Should Be Influenced by the Output of Existing CMYK Systems.

Thank You!

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