Not So Fast:

The Often Seen but Rarely Told Issues with ASTM Lightfastness Ratings

What does *that* have to do with Munsell?

And the answer is very much embodied by Joy Turner Luke, who I have had the great pleasure to know and collaborate with through my work with ASTM.

members and a number indicated interest in initiating upcoming projects.

The first program for Art, Design and Psychology Interest Group III set a precedent for quality programs in the future. There was concern for the overlapping of related groups and sessions and it is expected that this scheduling situation will be adjusted for the next annual meeting.

Magenta Yglesias and Wade Thompson, co-chairpersons.

Award Recipients. At ISCC Annual Meeting in Baltimore, May 9, 1988, Joy Turner Luke (left) receives Macbeth Award and Ruth Johnson-Feller receives Nickerson-ISCC Award. (Photo by Harry Hammond)

PRESIDENT JOY T. LUKE RECEIVES 1988 MACBETH AWARD
Citation by Hilton Brown

The Macbeth Award Fund was established by Norman Macbeth, Jr. in honor of his father, Norman Macbeth, who was president of the Macbeth Daylighting Corporation and a founding member of the ISCC. Norman Macbeth, Jr. was a former long-term treasurer of the ISCC and former Chairman of the Board of Kollmorgen Corporation which included in its member divisions the Macbeth Color Group. This award is presented biennially, in even numbered years.

The Macbeth Award is to be given for one or more recent outstanding contributions in the field of color. It is to be presented to a member or a former member of the Council. The contributions shall have advanced the field of color, interpreted broadly, as in the objectives of the Council defined by our constitution. The merit of a candidate shall be judged by his or her contributions to any of the fields of interest related to color, whether or not it is represented by any of the Member-Bodies. The contribution to color may be direct, it may be in the active practical stimulation of the application of color, or it may be an outstanding dissemination of knowledge of color by writing or lecturing. The candidates for the Macbeth Award need not have been active in the affairs of the Council.

It is a great pleasure to announce that our president-elect, Joy Turner Luke has been selected as the recipient of the 1988 Macbeth Award. In my opinion, the Macbeth Award Committee could not have made a better choice for the recipient of this important award.

Joy's contribution to the development and publication of quality and health standards for artists' paints and related materials has been immense. I will give you a brief introduction to her ongoing contributions concerning this subject. On April 18, 1977 when Ruth Johnston-Feller was chairman of ISCC Project Committees, the ISCC Project Committee #37 on Artists' Materials was formed sponsored by National Artists' Equity Association and chaired by Joy.

The first project was a study of the pigments used in the manufacture of artists' paints as well as the labeling practices used by these manufacturers. The late Henry Levison, owner of Permanent Pigments Artists' Material Company and Joy (both members of the National Bureau of Standards Standing Committee on Artists' Paints), working closely together were preparing for a revision of the obsolete NBS Commercial Standard CS98-62 on Artists' Oil Paints. Due to technical advances in testing methods beyond the scope of CS98-62, it was suggested by Nick Hale that contact should be established with the paint committee of the American Society for Testing and Materials (ASTM). Subsequently, an ASTM subcommittee on artists' paints and related materials was established with sponsorship by National Artists' Equity Association and chaired by Joy.

In 1979 the Bureau of Standards changed its policies on voluntary product standards, halting work on a revision of CS98-62. Since ASTM provided important technical expertise as well as excellent supervision on the development of standards it was decided to turn the revised CS98-62 into an ASTM specification. Under Joy's able leadership, the membership of the ISCC Committee #37 and the ASTM D01.57 Subcommittee became virtually identical. It was composed of artists, art conservators, analytical chemists and color scientists as well as artists' paint manufacturers and their chemists.

Due primarily to Joy's chairmanship of these two committees, the following Standards have been published by ASTM: D 4302 "Specification for Artists' Oil and Acrylic Emulsion Paints", D 4303 "Test Methods for Lightfastness of Pigments Used in Artists' Paints", and D 4236 "Practice for Labeling Art Materials for Chronic Health Hazards". Work continues to the present day under Joy's able and persuasive leadership on revisions to these standards and new standards are currently being written concerning lightfastness testing of art materials by artists, quality specifications on watercolor and gouache paints, and pencils.

Joy is a painter, lecturer, writer and teacher of color and artists' paints to painters, craftspersons, interior designers, and other professionals and students. For a number of years she has offered intensive workshops on color and artists' paints at her Studio 231 in Sperryville, VA. Beginning in 1960 she exhibited her paintings in juried exhibitions in the greater Washington, D.C. area including the following institutions: the Baltimore Museum of Art, the Smithsonian Institution, and the Corcoran Gallery of Art, among others and received several awards. She gave three one-person shows of her work at the Studio Gallery in Washington, D.C. and her paintings were handled by several private galleries. As a speaker she has lectured on color and

- 1977 Joy chaired the newly formed ISCC Project Committee #37 on Artists' Materials.

- First project was “a study of the pigments used in the manufacture of artists' paints as well as the labeling practices used by these manufacturers.”

- Henry Levison and Joy’s work on revising the NBS’s Commercial Standard on Artists' Oil Paints led to the creation of ASTM’s subcommittee on artists' paints and related materials, which Joy also chaired.

- “Under Joy's leadership, membership of ISCC’s Committee #37 and ASTM’s D01.57 Subcommittee became virtually identical. **It was composed of artists, art conservators, analytical chemists and color scientists as well as artists' paint manufacturers and their chemists.**”

- That while Joy was the chair, ASTM completed and published the following standards:
  - D 4302 "Specification for Artists' Oil and Acrylic Emulsion Paints“
  - D 4303 "Test Methods for Lightfastness of Pigments Used in Artists' Paints"
  - D4236 "Practice for Labeling Art Materials for Chronic Health Hazards".

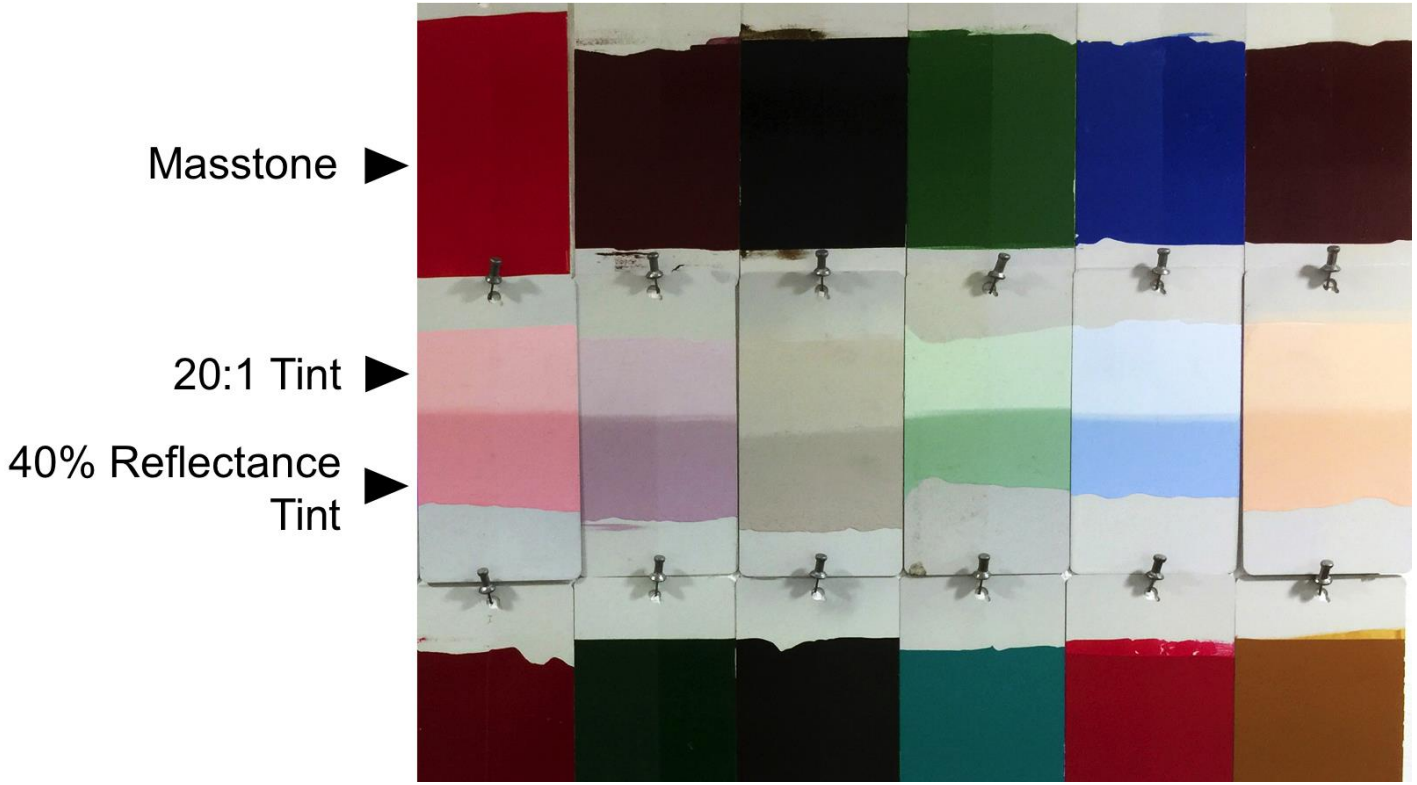
- And finally, the piece states, “….work continues to the present day under Joy's able and persuasive leadership on revisions to these standards and new standards are currently being written…..”

ASTM
American Society for Testing and Materials

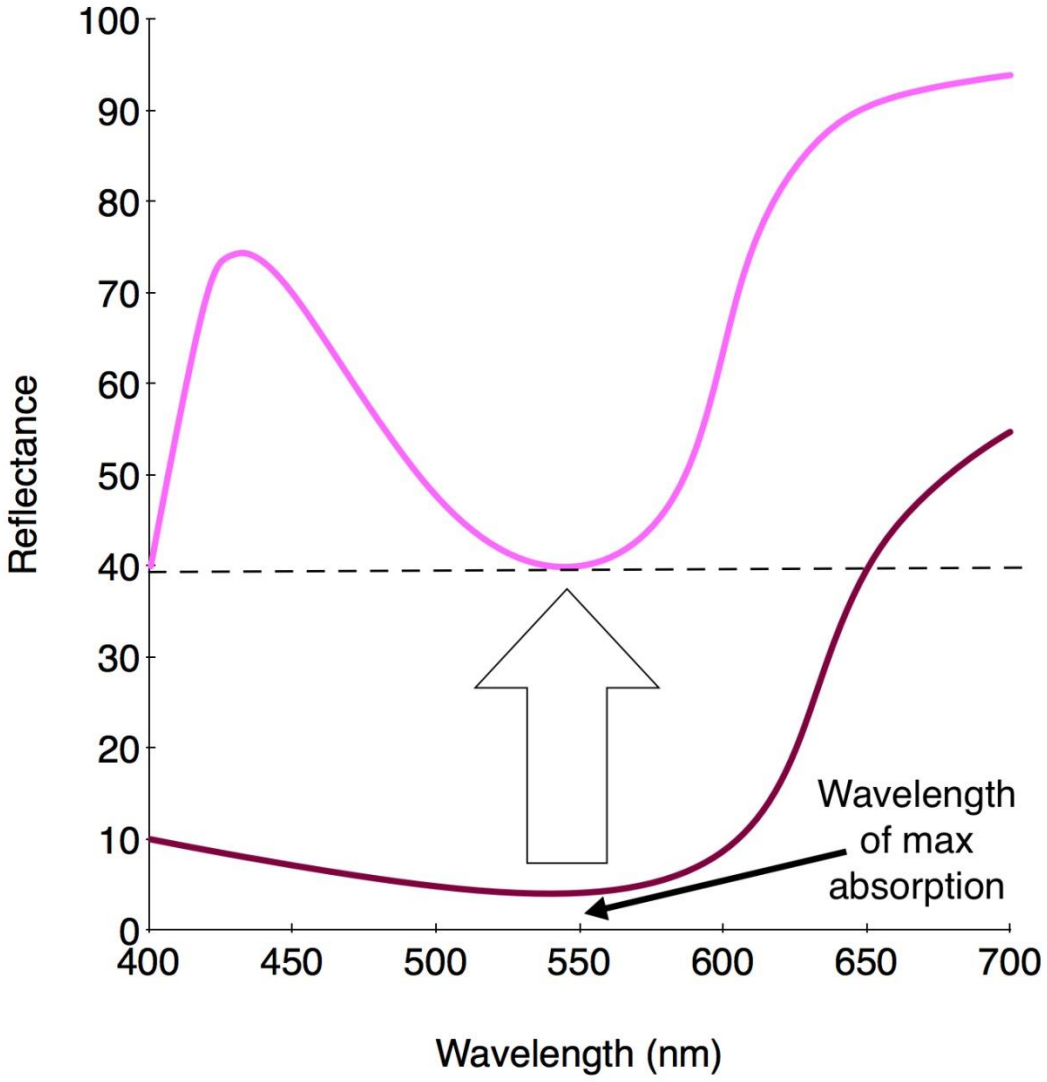
- One of the largest organizations in the world writing **voluntary** standards for materials, products, systems and services

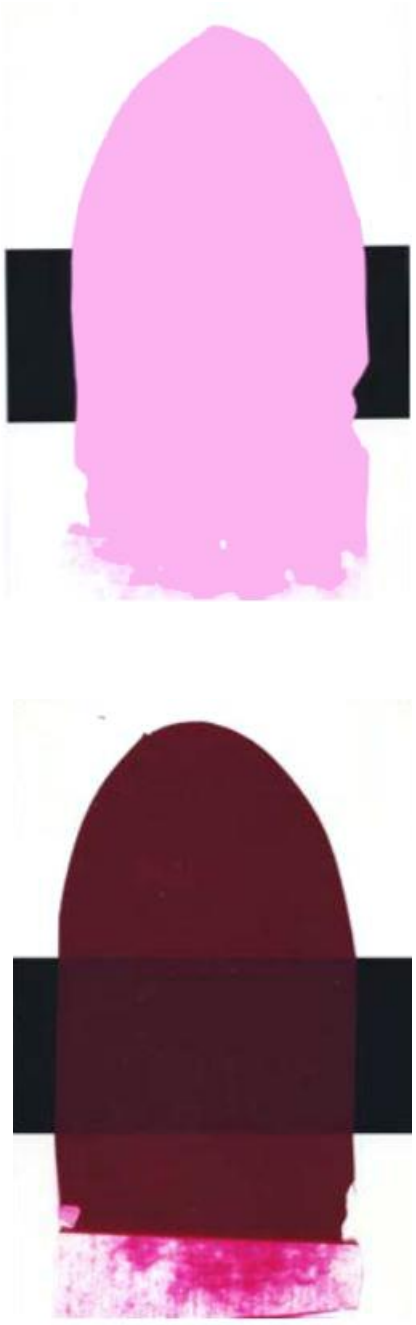
Some specific things to know about ASTM D4303's Lightfastness Testing

- Based solely on the performance of the 40% reflectance tint of a color



40% Reflectance Tint





A Word on the Whites Used for Tinting

The white used to create 40% reflectance tints depends on which paint you are testing.

- Acrylics: one simply uses the Titanium White from the same brand one is testing.

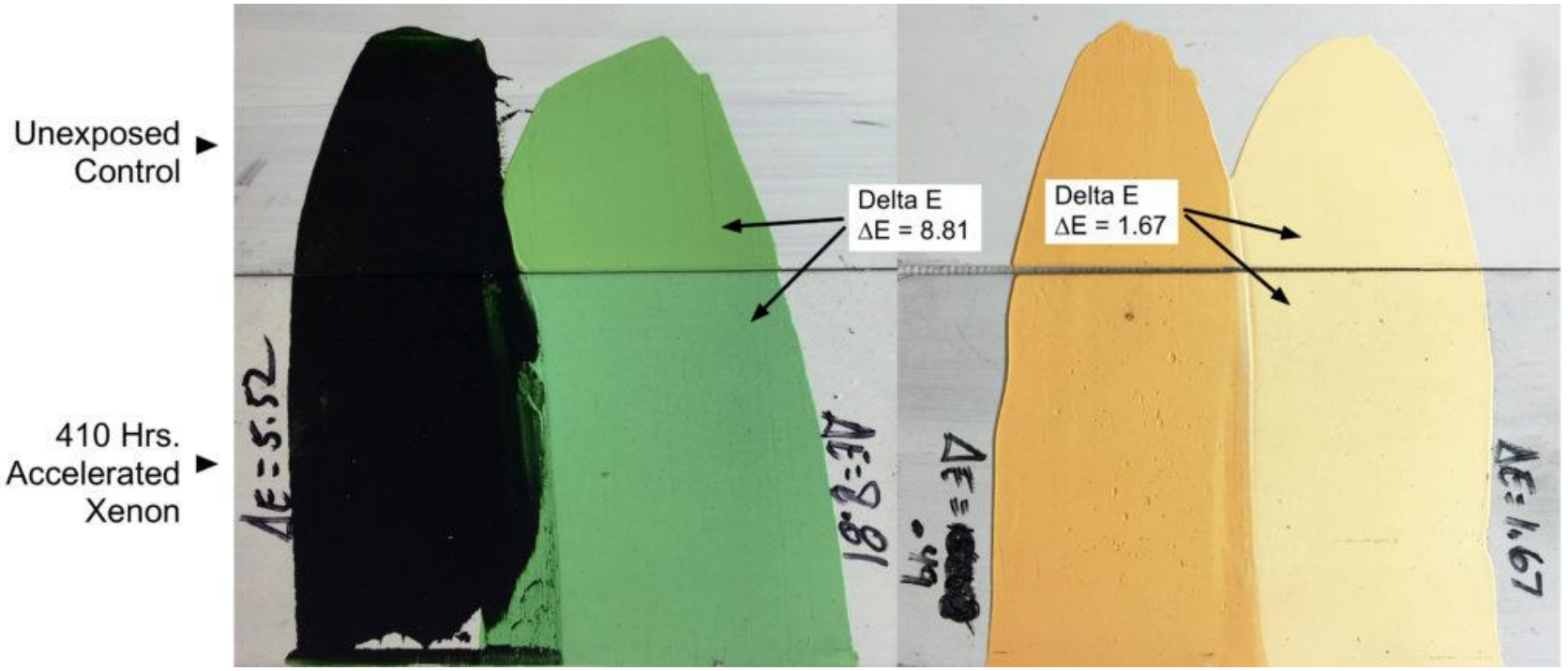
- Oils: manufacturers must make and use a specified safflower titanium white containing, by weight, 39.5% blanc fix, 30% rutile titanium dioxide, 6% zinc oxide, and 2% aluminum stearate.

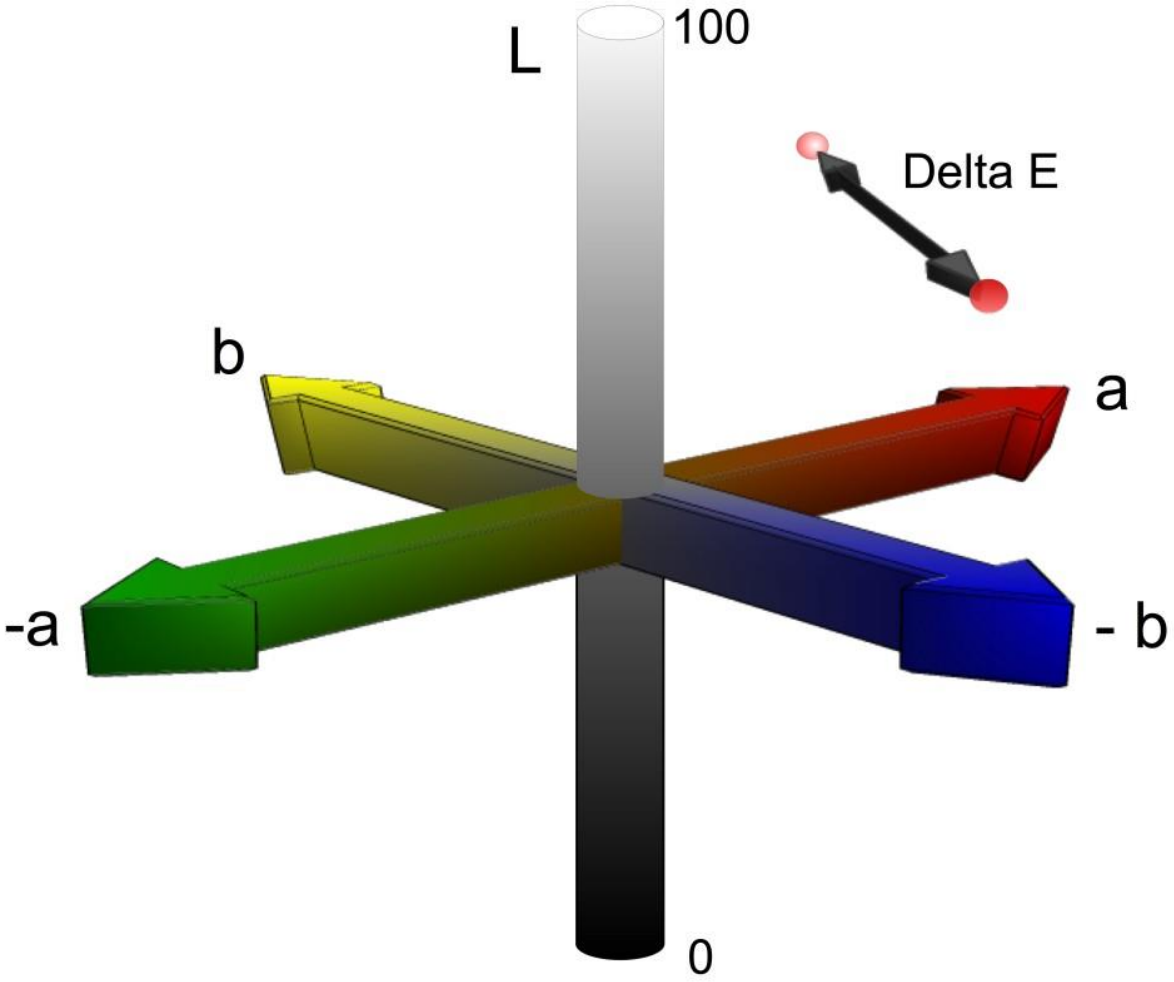
ASTM D4303 Accelerated Lightfastness Testing

Xenon Arc Test Chamber
410 hrs - Total irradiance of 510 kJ/M^2

Outdoor under glass in Arizona or South Florida
Approximately 3 months for total irradiance of 1260 MJ/M^2

The samples are then evaluated for how much they have changed in color from an unexposed control, using a spectrophotometer to calculate the Delta E.





Model of CIE Lab space showing an example of Delta E as the distance between two colors.

The Delta E then informs what lightfastness rating it is assigned:

ASTM Lightfastness	Delta E	Approximate Blue Wool Equivalent	Description
I	0-4	7-8	Excellent
II	4-8	6	Very Good
III	8-16	4-5	Fair

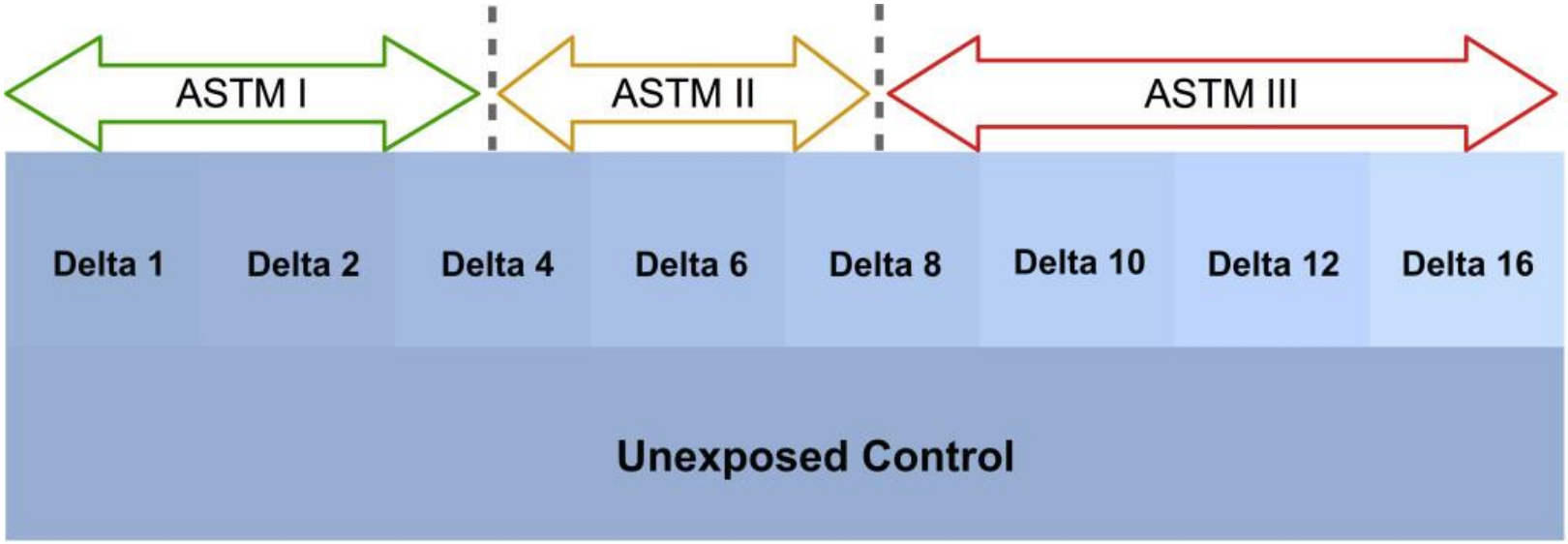


TABLE 1 Suitable Pigment List

NOTE 1—Underlined information and the lightfastness rating in the table shall be included on every label.

Key:

Lightfastness Category:

Lightfastness I Excellent Lightfastness
Lightfastness II Very Good Lightfastness

Abbreviations used in Colour Index Names:

PB	Pigment Blue
PBk	Pigment Black
PBr	Pigment Brown
PG	Pigment Green
PO	Pigment Orange
PR	Pigment Red
PV	Pigment Violet
PW	Pigment White
PY	Pigment Yellow

Pigment Notations:

(AR)	Alkali Resistant
(CC)	Concentrated cadmium pigments may contain up to 15 % barium sulfate for color control. Cadmium-barium pigments contain a much higher amount of barium sulfate.
(DL)	May darken in strong light
(LF)	Lightfast type
(NA)	Colour index name or number not assigned
(RS)	Red shade
(SM)	Sensitive to moisture in direct sunlight
(SS)	Sensitive to hydrogen sulfide

Colour Index Name	Lightfastness Category Acrylic	Common Name and Chemical Class	Colour Index Number
		YELLOWS	
PY 3	II	Arylide Yellow 10G, with option of adding the name Hansa Yellow Light, arylide yellow	11710
PY 35	I	Cadmium (hue designation), concentrated cadmium zinc sulfide (CC) (SM)	77205
PY 35:1	I	Cadmium-(hue designation), cadmium zinc sulfide coprecipitated with barium sulfate (SM)	77205:1
PY 37	I	Cadmium (hue designation), concentrated cadmium sulfate (CC) (SM)	77199
PY 37:1	I	Cadmium-Barium (hue designation), cadmium sulfide coprecipitated with barium sulfate (SM)	77199:1
PY 42	I	Mars Yellow or Iron Oxide Yellow, with option of adding the name Yellow Iron Oxide, synthetic hydrated iron oxide	77492
PY 42	I	Mars Orange or Iron Oxide Orange, synthetic hydrated iron oxide	77492
PY 43	I	Yellow Ochre, natural hydrated iron oxide	77492
PY 53	I	Nickel Titanate Yellow, oxides of nickel, antimony and titanium	77788
PY 65	I	Arylide Yellow RN, with option of adding Hansa Yellow RN, arylide yellow	11740
PY 73	I	Arylide Yellow GX, with option of adding the name Hansa Yellow GX, arylide yellow	11738
PY 74 (LF)	I	Arylide Yellow 5Gx, with option of adding Hansa Yellow 5GX, arylide yellow	11741
PY 83 (HR70)	I	Diarylide Yellow HR70, diarylide yellow	21108
PY 97	I	Arylide Yellow FGL, arylide yellow	11767
PY 98	I	Arylide Yellow 10GX, with option of adding the name Hansa Yellow 10GX, arylide yellow	11727


Ultramarine Blue
PB 29
Lightfastness I
Conforms to ASTM D 5098
#1400-2 / Series 2
2 fl. oz. / 59 ml
GOLDEN
ACRYLICS

Issues we will look at include:

- Current ratings are based on samples done at one point in time often from one or very limited number of pigment sources and paint brands.
- Pigment processing and quality change over time causing unsuspected issues with lightfastness if not retested.
- Variables caused by the choice of white used for creating tints for ASTM Lightfastness testing in D4302 (Standard for Oil Paints)

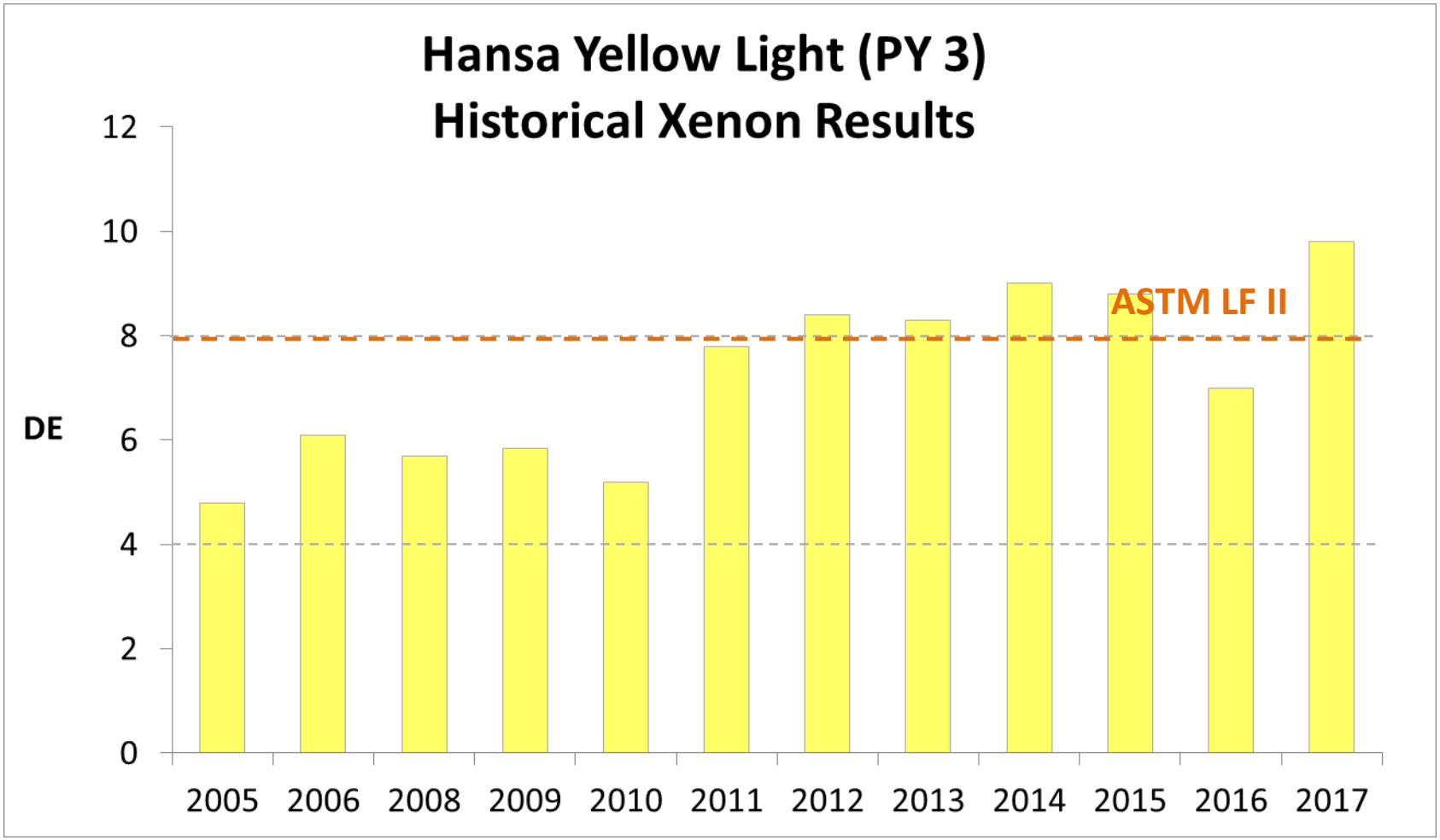
The Problem of Change Over Time

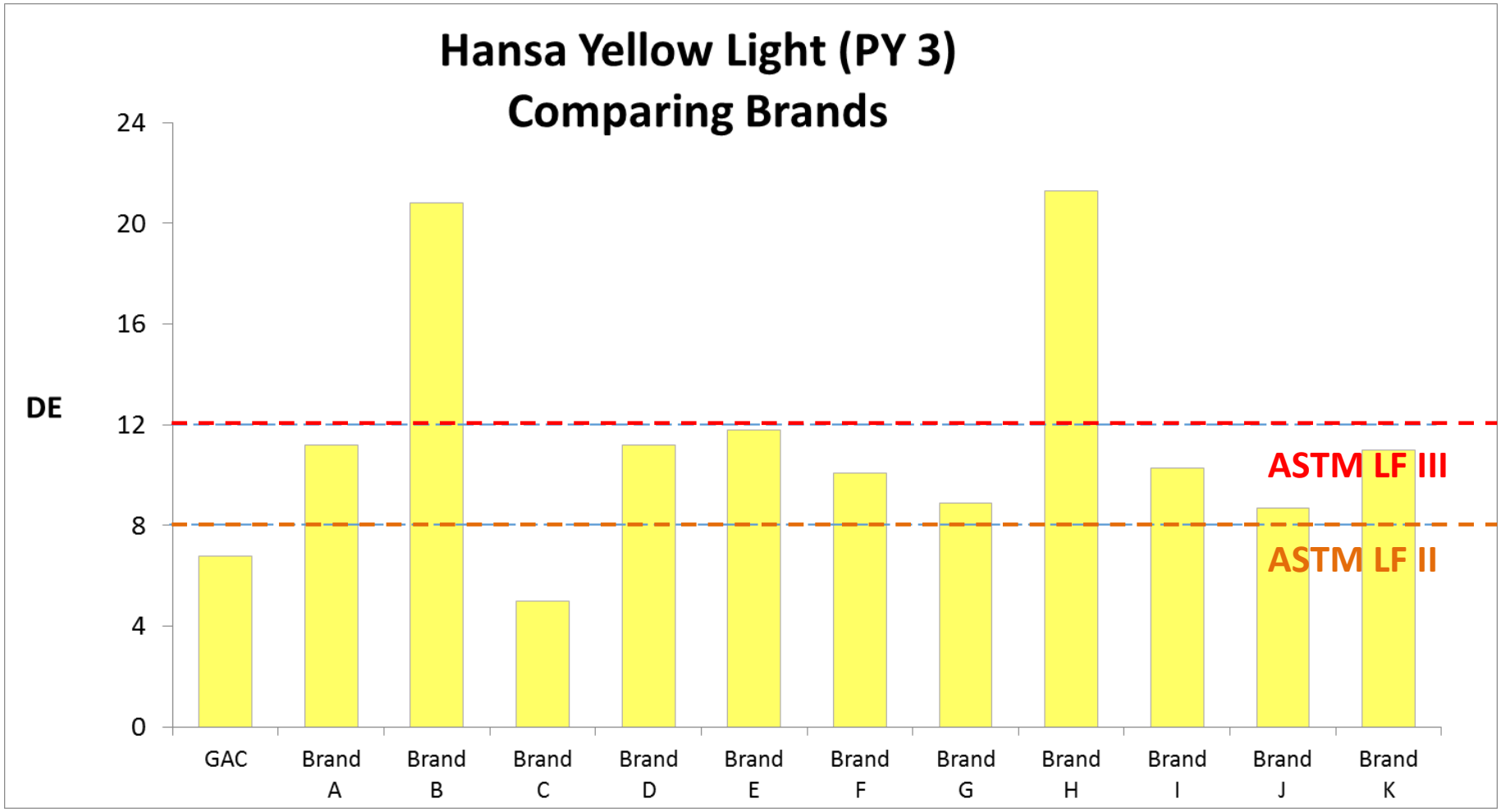
- - -

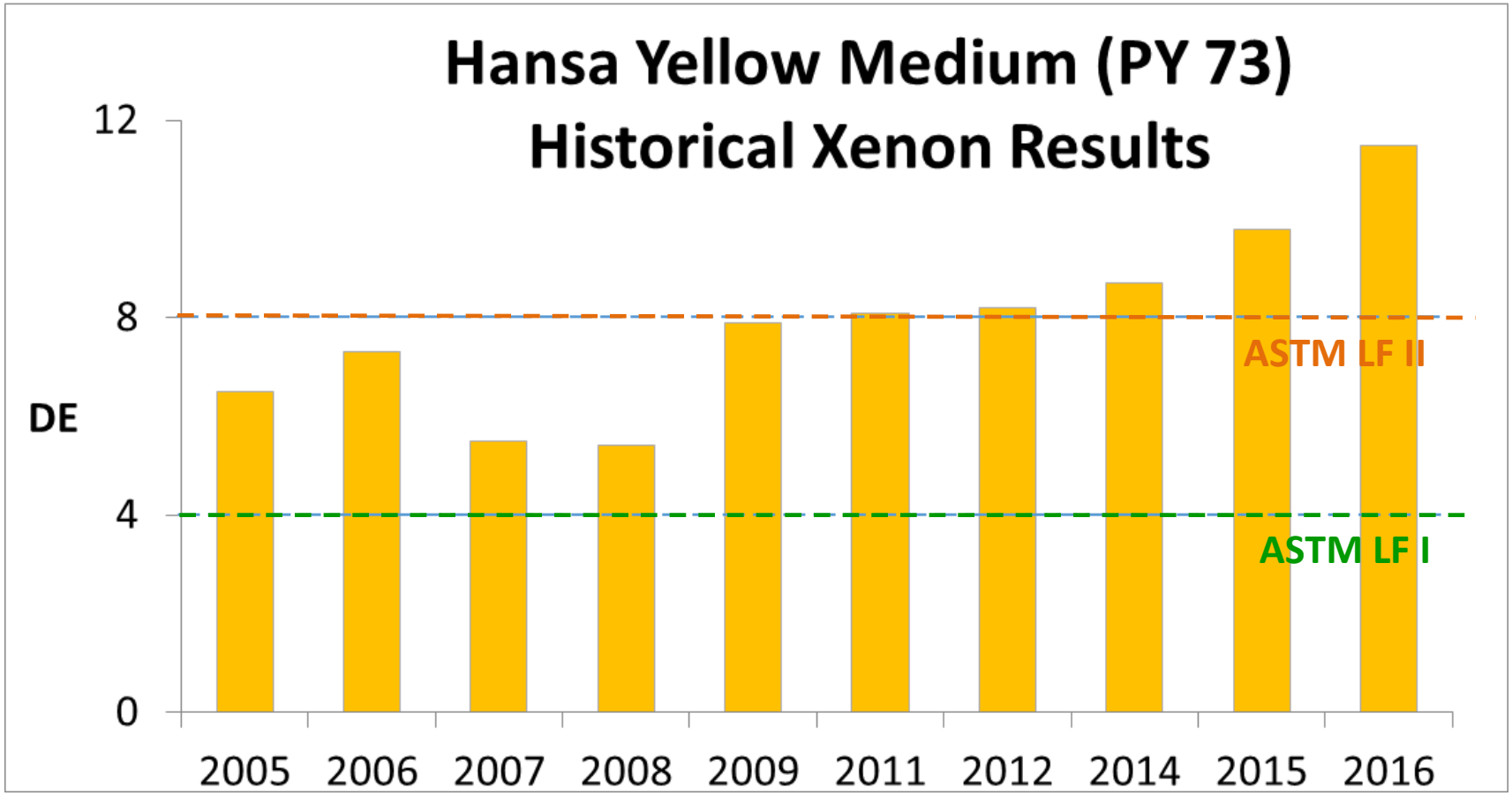
Hansa Yellow Light and Medium (PY 3, PY 73)

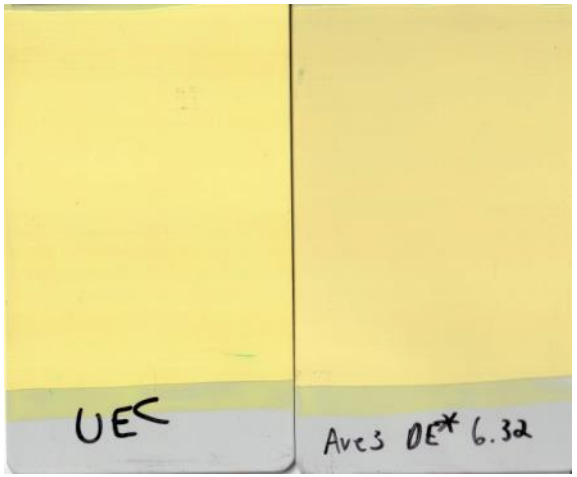
Colour Index Name	Lightfastness Category Acrylic	Common Name and Chemical Class	Colour Index Number
		YELLOWS	
PY 3	II	Arylide Yellow 10G, with option of adding the name Hansa Yellow Light, arylide yellow	11710
PY 35	I	Cadmium (hue designation), concentrated cadmium zinc sulfide (CC) (SM)	77205
PY 35:1	I	Cadmium-(hue designation), cadmium zinc sulfide coprecipitated with barium sulfate (SM)	77205:1
PY 37	I	Cadmium (hue designation), concentrated cadmium sulfate (CC) (SM)	77199
PY 37:1	I	Cadmium-Barium (hue designation), cadmium sulfide coprecipitated with barium sulfate (SM)	77199:1
PY 42	I	Mars Yellow or Iron Oxide Yellow, with option of adding the name Yellow Iron Oxide, synthetic hydrated iron oxide	77492
PY 42	I	Mars Orange or Iron Oxide Orange, synthetic hydrated iron oxide	77492
PY 43	I	Yellow Ochre, natural hydrated iron oxide	77492
PY 53	I	Nickel Titanate Yellow, oxides of nickel, antimony and titanium	77788
PY 65	I	Arylide Yellow RN, with option of adding Hansa Yellow RN, arylide yellow	11740
PY 73	I	Arylide Yellow GX, with option of adding the name Hansa Yellow GX, arylide yellow	11738
PY 74 (LF)	I	Arylide Yellow 5Gx, with option of adding Hansa Yellow 5GX, arylide yellow	11741
PY 83 (HR70)	I	Diarylide Yellow HR70, diarylide yellow	21108

ASTM Lightfastness	Delta E	Approximate Blue Wool Equivalent	Description
I	0-4	7-8	Excellent
II	4-8	6	Very Good
III	8-16	4-5	Fair

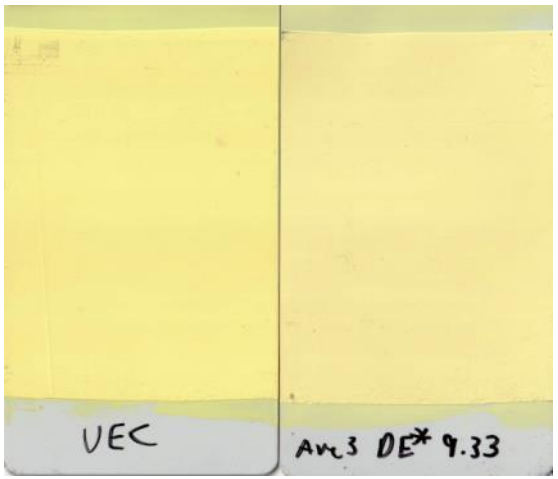

Hansa Yellow Light (PY 3)
Historical Xenon Results
DE
12
10
8
6
4
2
0
ASTM LF II
2005
2006
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017


Hansa Yellow Light (PY 3)
Comparing Brands
DE
24
20
16
12
8
4
0
ASTM LF III
ASTM LF II
GAC
Brand A
Brand B
Brand C
Brand D
Brand E
Brand F
Brand G
Brand H
Brand I
Brand J
Brand K

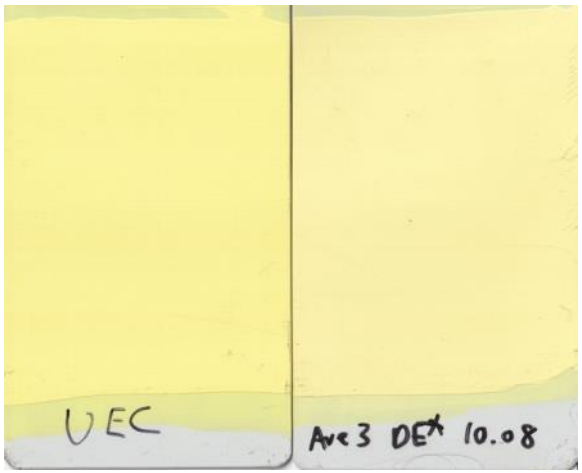

Hansa Yellow Medium (PY 73)
Historical Xenon Results
DE
12
8
4
0
ASTM LF II
ASTM LF I
2005
2006
2007
2008
2009
2011
2012
2014
2015
2016



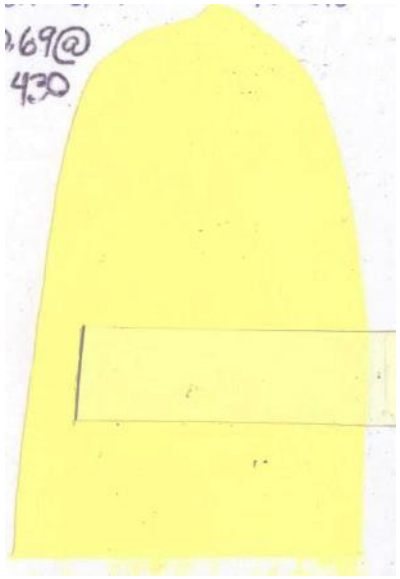
HYM 2007
DE 6.32



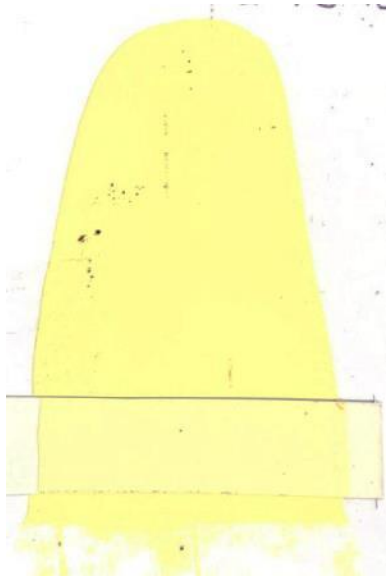
HYM 2012
DE 9.33



HYM 2015
10.08

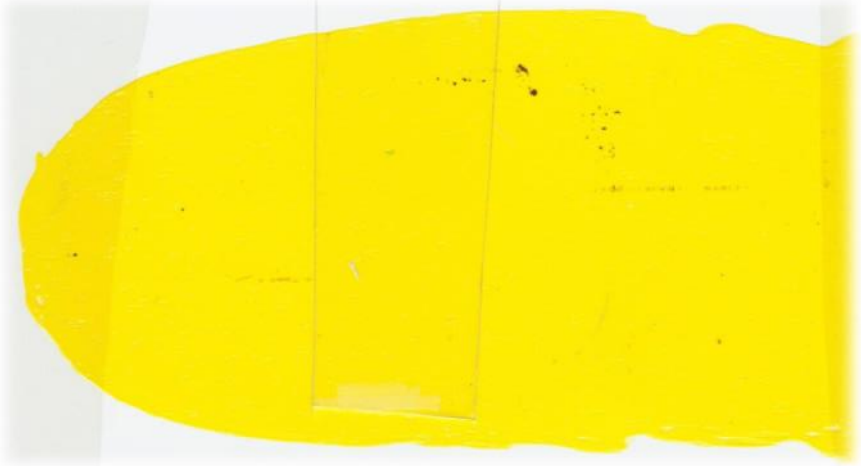


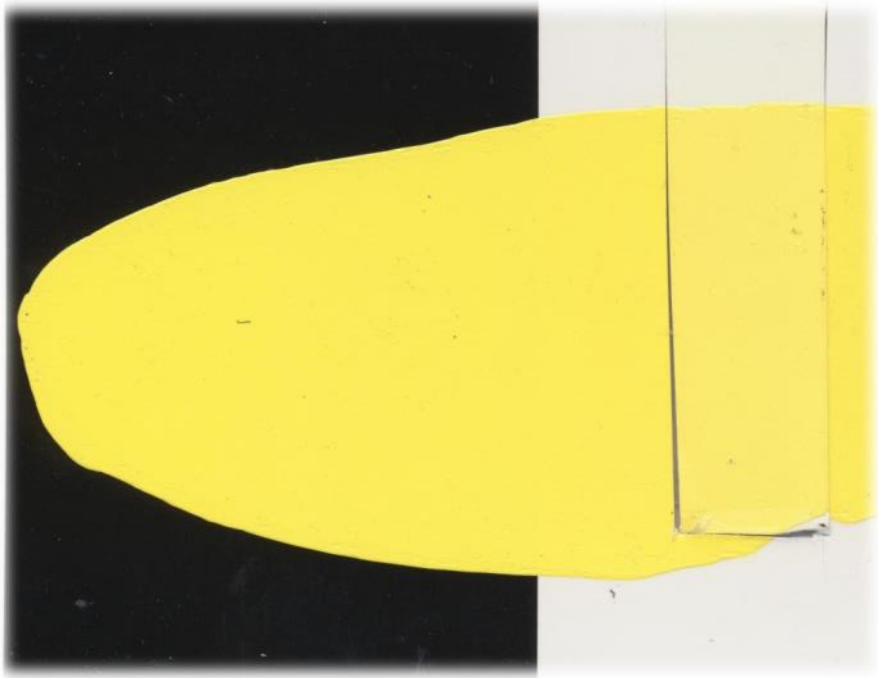
HYL 2013
DE 10.10

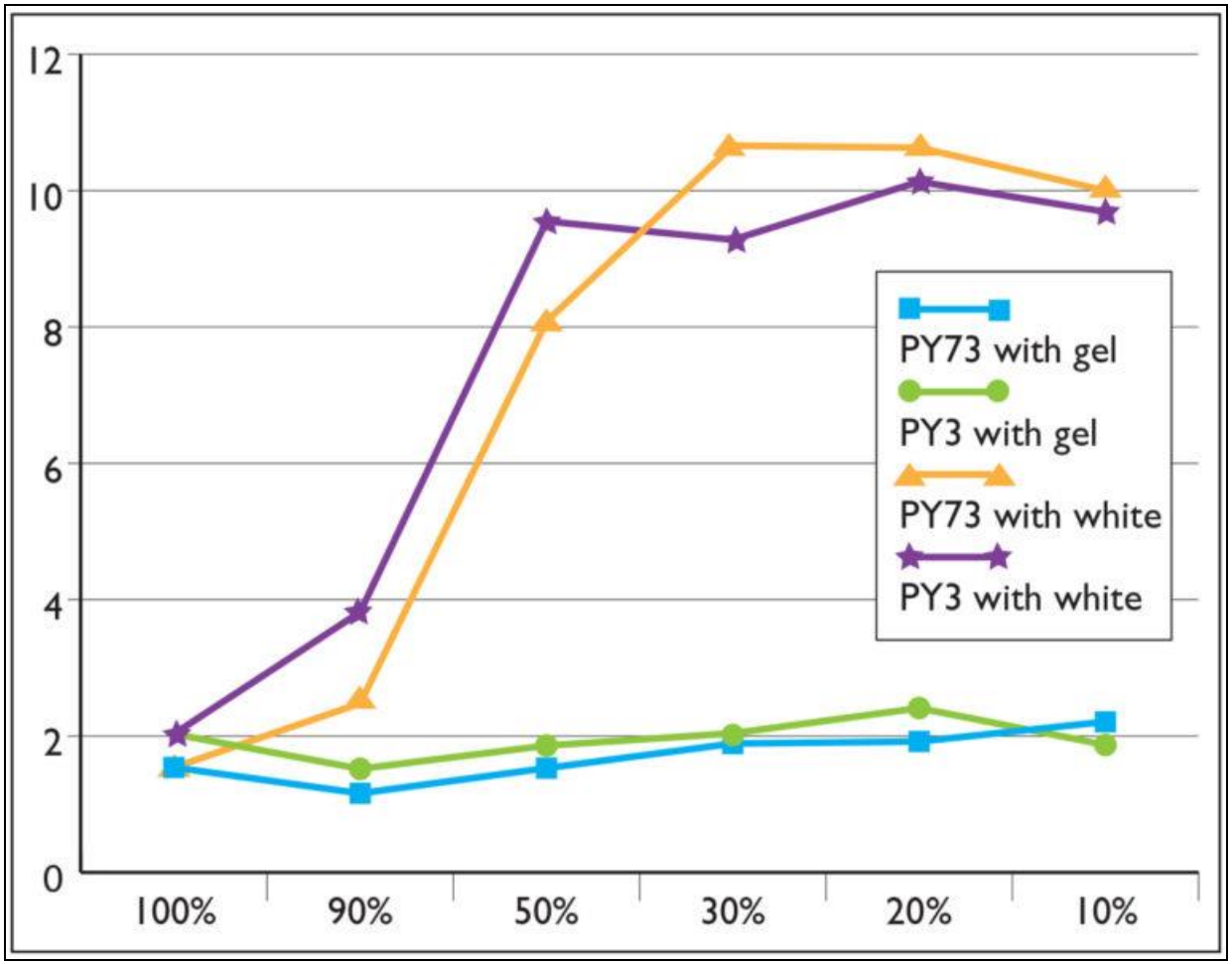


HYL 2015
DE 9.29

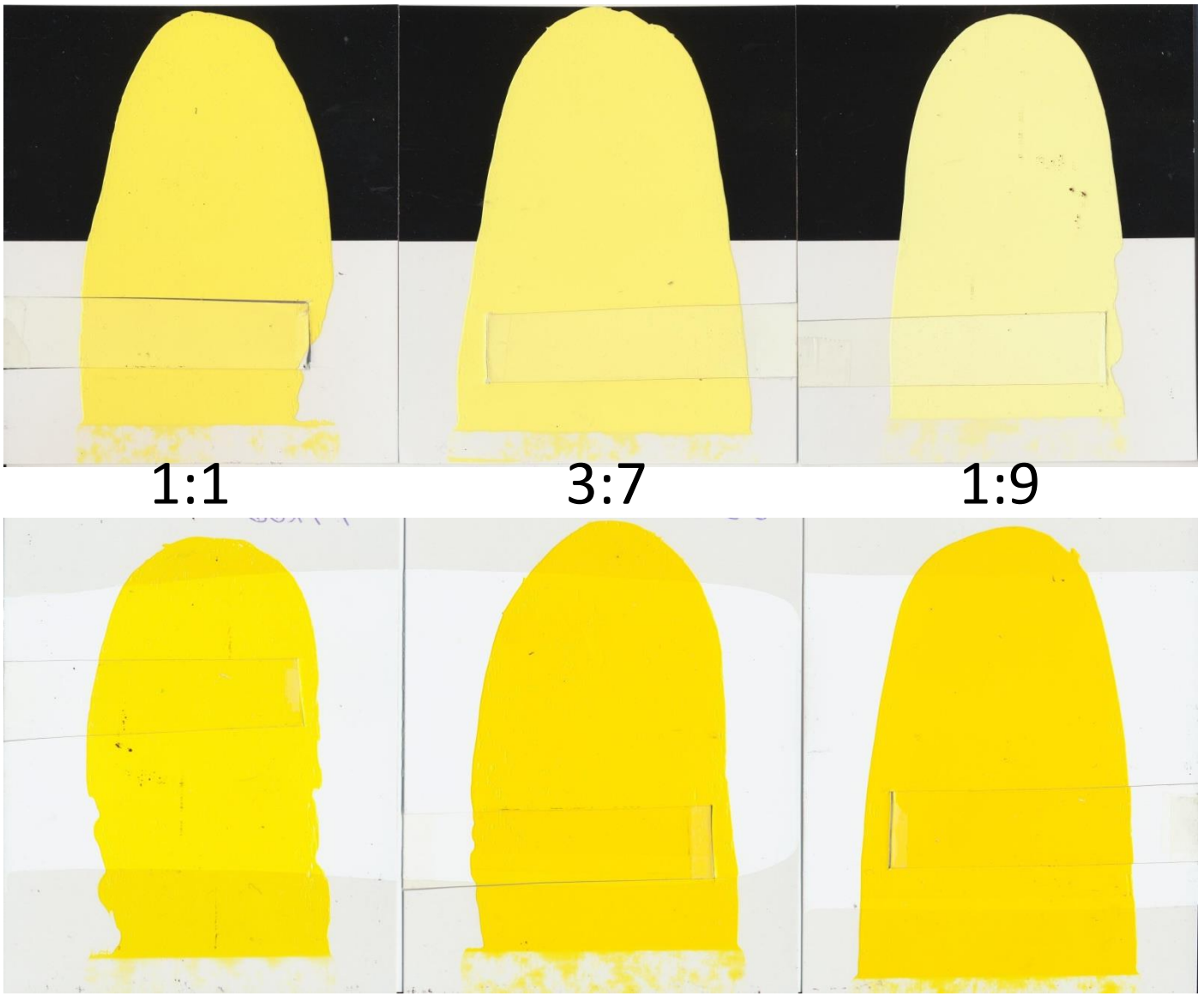
Tints
vs
Transparencies
- - -
Hansa Yellow
Light and
Medium
(PY 3, PY 73)



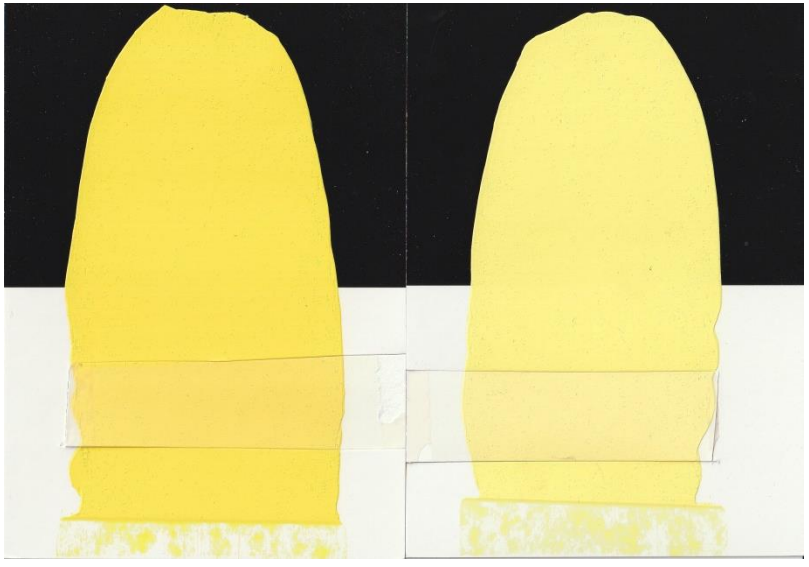



12
10
8
6
4
2
0
100%
90%
50%
30%
20%
10%
PY73 with gel
PY3 with gel
PY73 with white
PY3 with white

Hansa Yellow Light (PY 3)



Hansa Yellow Medium (PY 73)



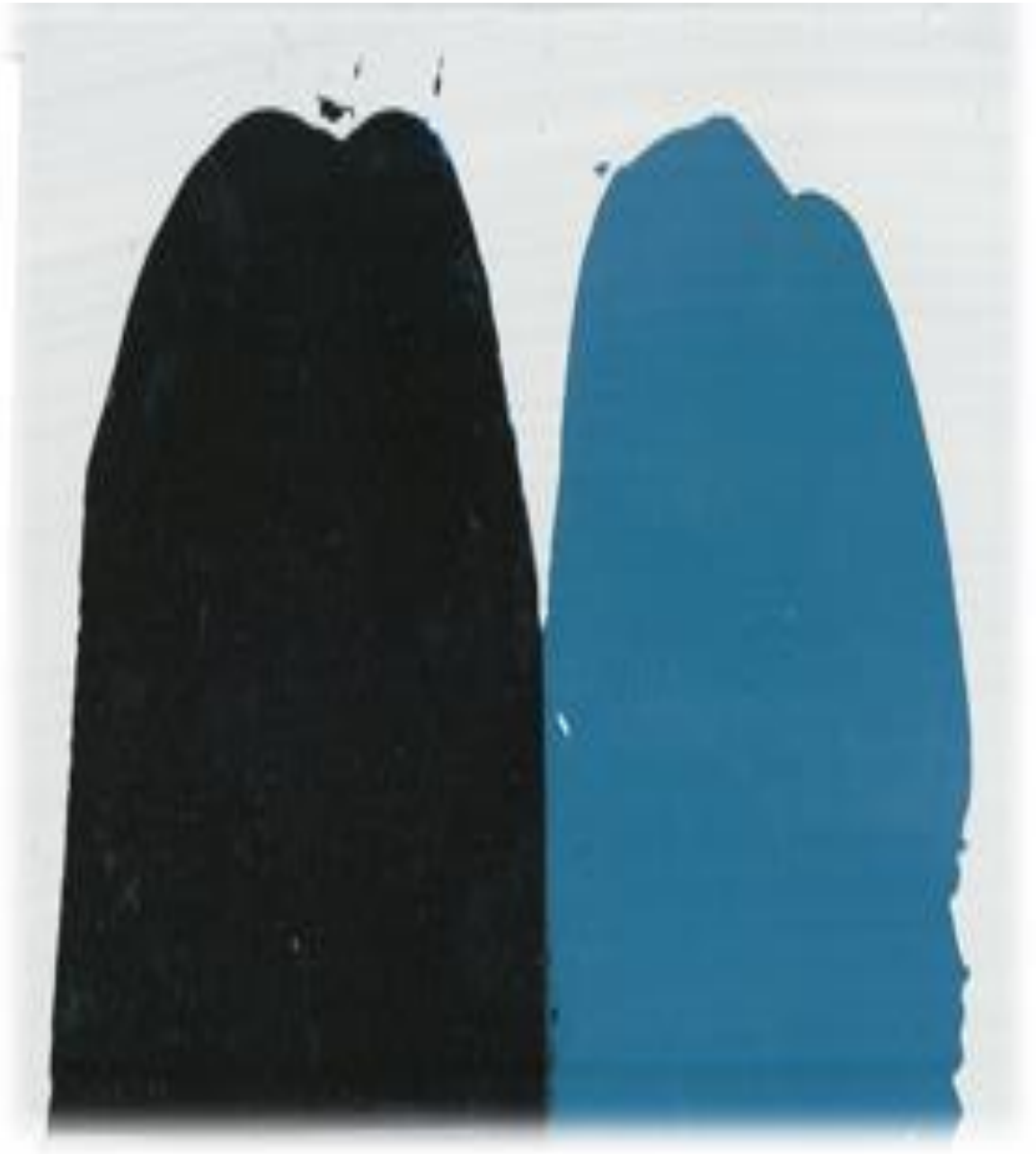
3:7 1:9

The Problem of Different Whites

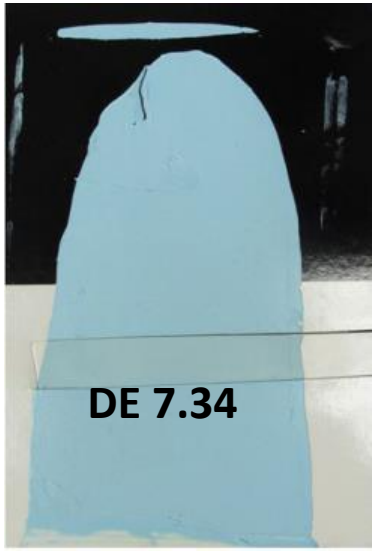
Case Study #I

- - -

Prussian Blue (PB 27)

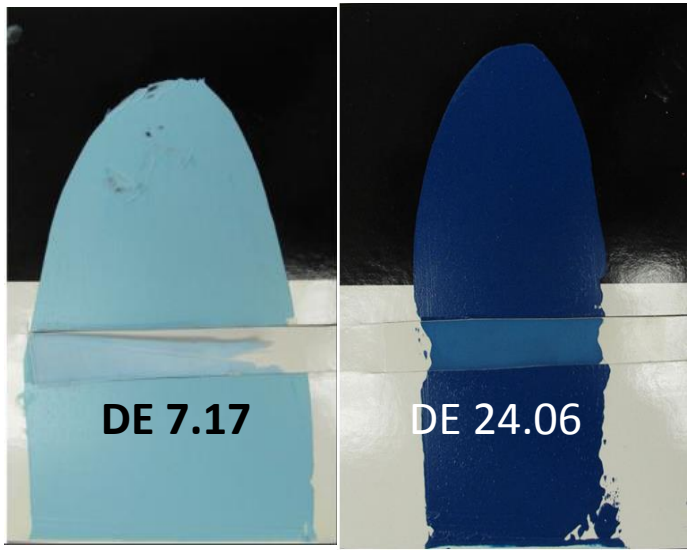


Xenon 510 kJ/m2



Titanium White

Flake White

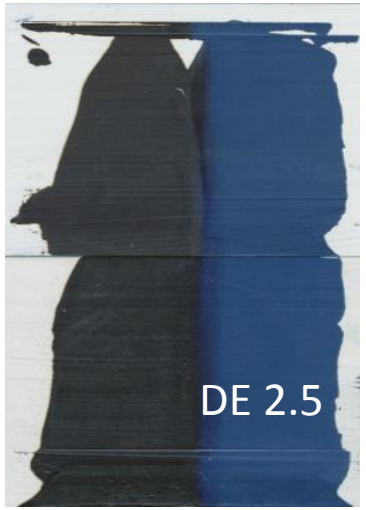


Zinc White

Florida 1260 MJ/m2

ASTM Safflower TW

Flake White



Flake White

Indanthrone Blue (PB 60)

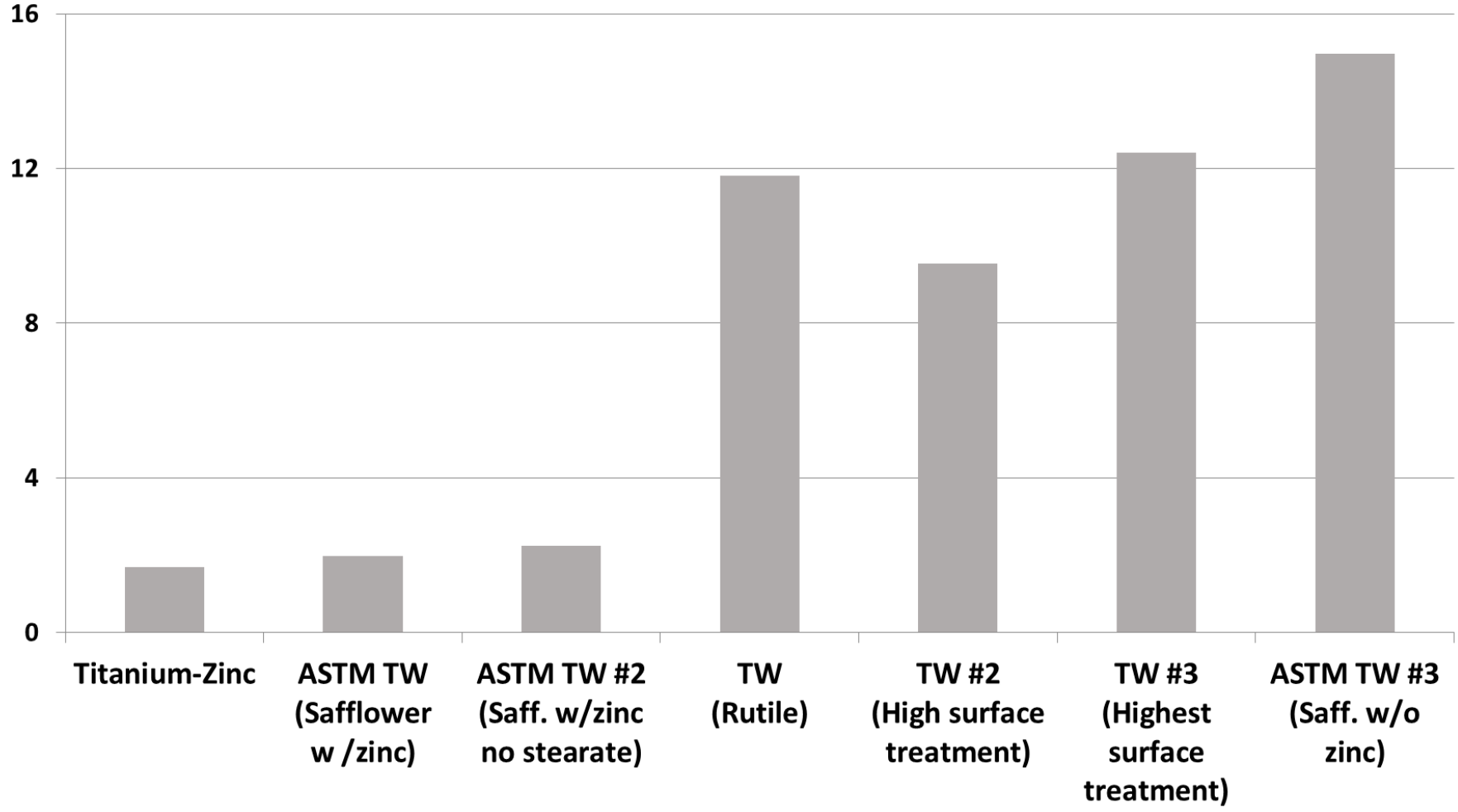
The Problem of Different Whites

Case Study #2

- - -

Pyrrole Orange (PO 73)

Lightfastness Results for Pyrrole Orange (PO 70) Mixed with Different Tinting Whites

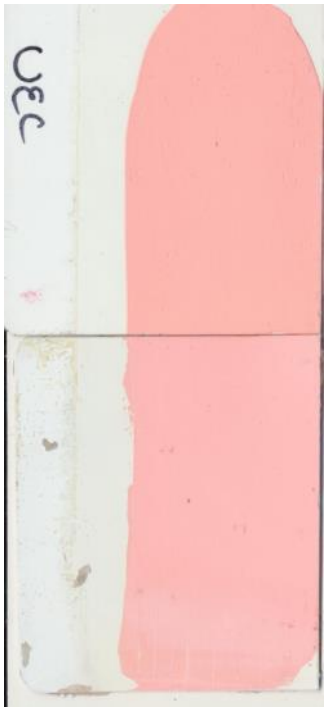


Unexposed Controls

Arizona 1260 MJ/m2

Titanium-Zinc (Linseed)

DE 1.68



ASTM TW (Safflower w /zinc)

DE 1.98

Titanium White (Linseed)

DE 11.82

ASTM TW (Safflower w/o zinc)

DE 14.96

Pyrrole Orange w/ Diff. Whites (Xenon 510 kJ/m2)

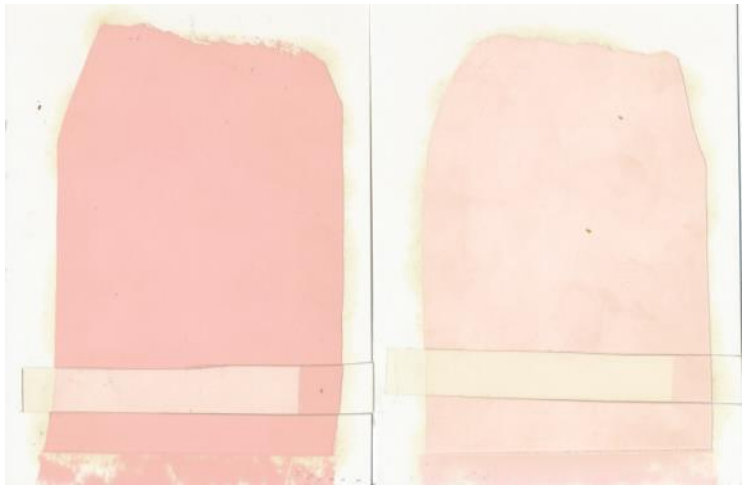
40% Reflectance

20:1 (white:color)

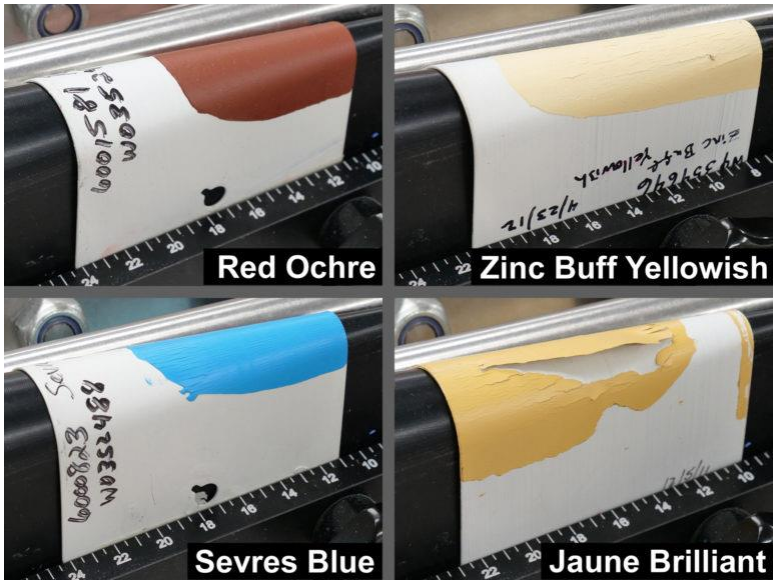
ASTM Saff. TW w/ Zinc

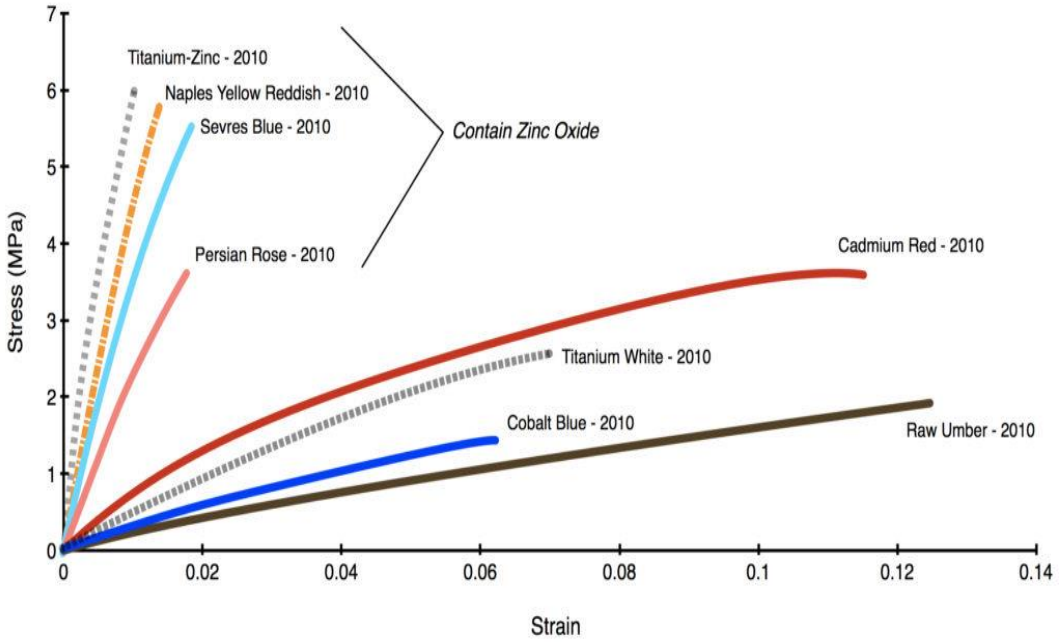
TW w/ High Surf. Treatment

Titanium White

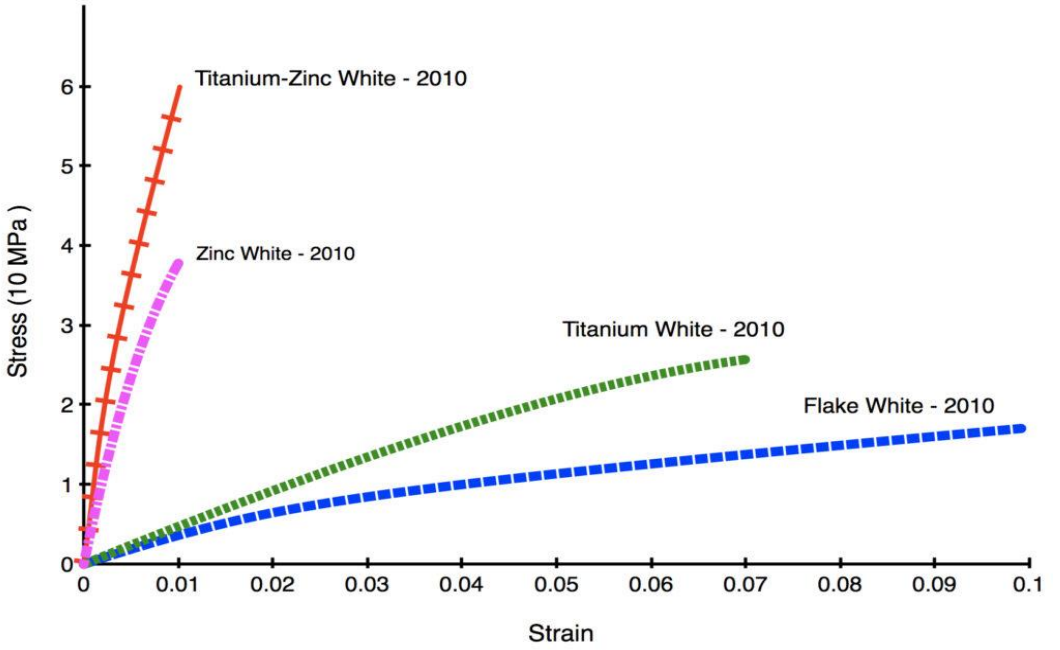


Titanium White in Walnut Oil


Red Ochre
Zinc Buff Yellowish
Sevres Blue
Jaune Brilliant

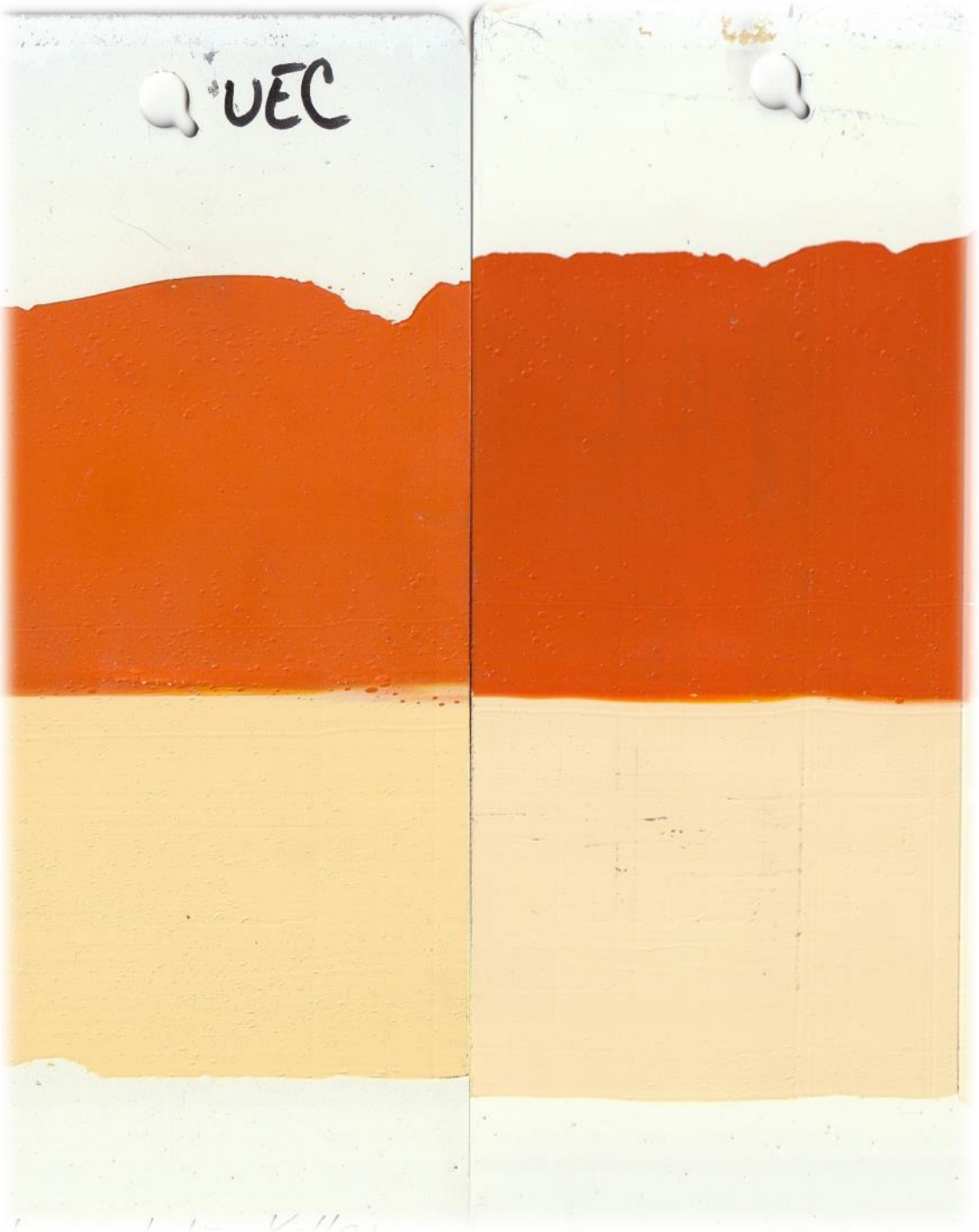

Titanium-Zinc - 2010
Naples Yellow Reddish - 2010
Sevres Blue - 2010
Contain Zinc Oxide
Persian Rose - 2010
Cadmium Red - 2010
Titanium White - 2010
Cobalt Blue - 2010
Raw Umber - 2010
Stress (MPa)
Strain
0
1
2
3
4
5
6
7
0.02
0.04
0.06
0.08
0.1
0.12
0.14


Flake White
Titanium White
Silver White
Titanium - Zinc White


Titanium-Zinc White - 2010
Zinc White - 2010
Titanium White - 2010
Flake White - 2010
Stress (10 MPa)
Strain
0
1
2
3
4
5
6
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1

Assigning Lightfastness by the Book:

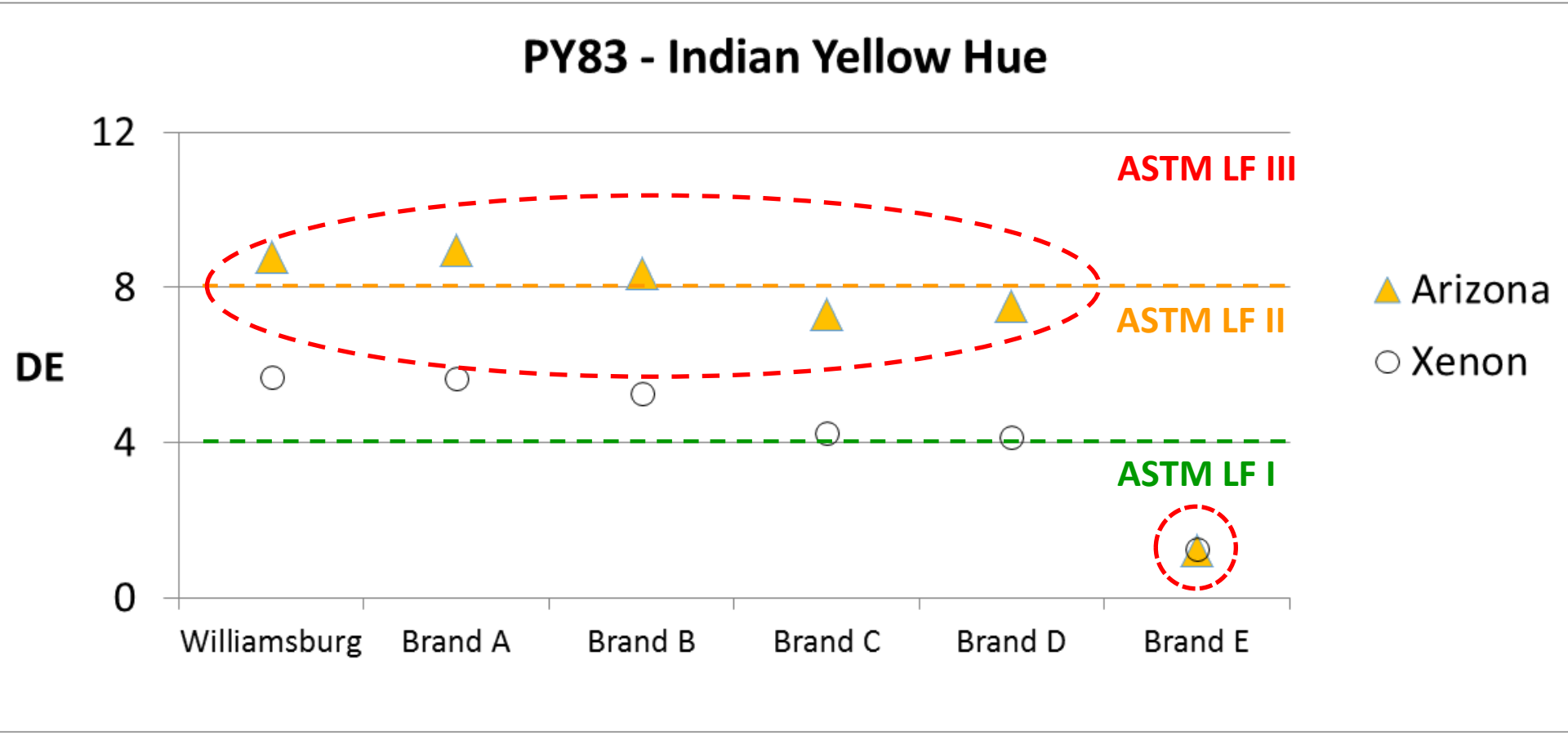
Issues with ‘Indian Yellows’ Based on Diarylide Yellow (PY 73)



ASTM Pigment Lookup Tables

Listing from ASTM D4302 – *Standard Specification for Artists Oil, Resin-Oil, and Alkyd Paints*

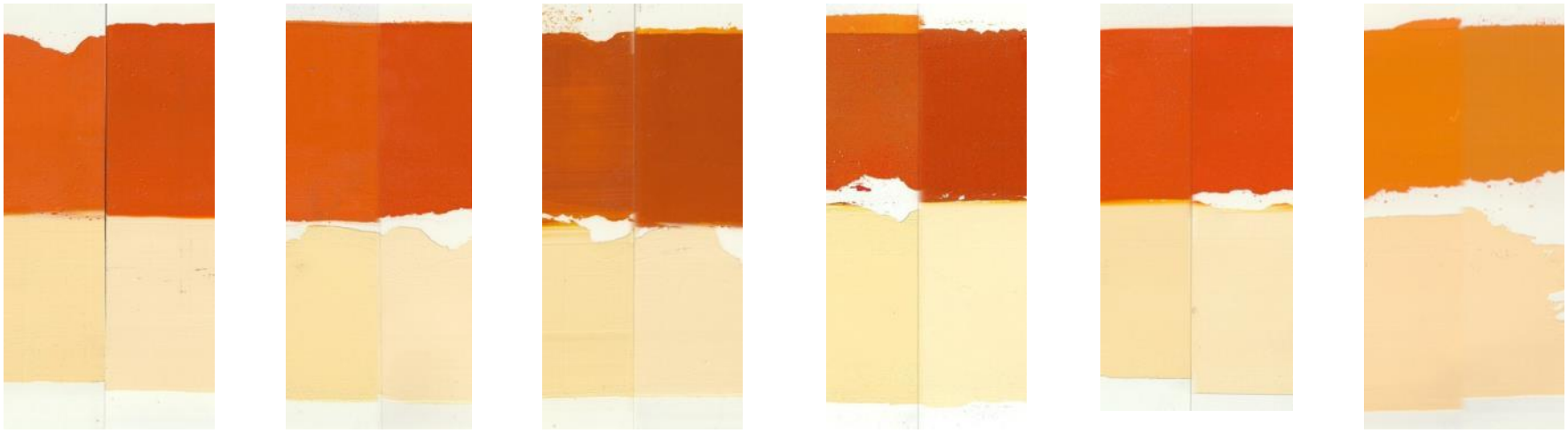
Colour Index Name	Lightfastness Category		Common Name and Chemical Class	Colour Index Number
	Oil and Resin-Oil	Alkyd		
			YELLOWS	
PY 3	II	II	Arylide Yellow 10G, with option of adding the name Hansa Yellow Light, Organic: monoazo, acetoacetyl, 10G	11710
PY 35	I	...	Cadmium (hue designation), Inorganic: cadmium zinc sulfide (CC) (SM)	77205
PY 35:1	I	...	Cadmium-Barium (hue designation), Inorganic: cadmium zinc sulfide coprecipitated with barium sulfate (SM)	77205:1
PY 37	I	I	Cadmium (hue designation), Inorganic: cadmium sulfide (CC) (SM)	77199
PY 37:1	I	...	Cadmium-Barium (hue designation) Inorganic: cadmium sulfide coprecipitated with barium sulfate (SM)	77199:1
PY 40	II	...	Aureolin, or Cobalt Yellow, Inorganic: potassium cobaltinitrite	77357
PY 41	I	...	Naples Yellow, Inorganic: lead antimoniate (SS)	77589
PY 42	I	...	Mars Yellow or Iron Oxide Yellow, Inorganic: synthetic hydrated iron oxide	77492
PY 42	I	...	Mars Orange or Iron Oxide Orange, Inorganic: synthetic hydrated iron oxide	77492
PY 43	I	I	Yellow Ochre, Inorganic: natural hydrated iron oxide	77492
PY 53	I	...	Nickel Titanate Yellow, Inorganic: oxides of nickel, antimony and titanium	77788
PY 65	I	...	Arylide Yellow RN, with option of adding Hansa Yellow RN, Organic: monoazo, acetoacetyl RN	11740
PY 73	I	...	Arylide Yellow GX, with option of adding the name Hansa Yellow GX, Organic: monoazo, acetoacetyl, GX	11738
PY74(LF)	I	...	Arylide Yellow 5GX, with option of adding Hansa Yellow 5GX, Organic: monoazo: acetoacetyl 5GX	11741
PY 83 HR 70	I	...	Diarylide Yellow HR70, Organic: disazo, HR 70	21108
PY 97	I	...	Arylide Yellow FGL, Organic: monoazo, acetoacetyl FGL	11767
PY 98	II	...	Arylide Yellow 10GX, with the option of adding the name Hansa Yellow 10GX, Organic: monoazo, acetoacetyl, 10GX	11727
PY 108	I	...	Anthrapyrimidine Yellow, Organic: anthraguinone	68420
PY 109	I	...	Isoindolinone Yellow G, Organic: aminoketone, G tetrachloroisoindolinone	56284
PY 110	I	...	Isoindolinone Yellow R, Organic: aminoketone, R tetrachloroisoindolinone	56280


PY83 - Indian Yellow Hue
DE
12
8
4
0
ASTM LF III
ASTM LF II
ASTM LF I
Arizona
Xenon
Williamsburg
Brand A
Brand B
Brand C
Brand D
Brand E

PY 83
"Fair"

These all appear to be the transparent, and less lightfast version of PY83, but are listed as having either Excellent or ASTM I Lightfastness, and at least one lists the pigment as being PY83 HR70.

This actually appears to be HR70 but is listed as simply PY 83. Although is correctly labeled as ASTM LF I.



Williamsburg
DE 8.80

Brand A
DE 8.97

Brand B
DE 8.38

Brand C
DE 7.33

Brand D
DE 7.54

Brand E
DE 1.20

The Challenges Ahead

- The issue is not with the science or the testing or even, really, the amount of work involved in the development of a better standard
- The problem is engagement and caring and passion. We need to go back to that initial vision of Joy's:
  - "Under Joy's leadership, membership of ISCC's Committee #37 and ASTM's D01.57 Subcommittee became virtually identical. **It was composed of artists, art conservators, analytical chemists and color scientists as well as artists' paint manufacturers and their chemists.**"
- In the end, as in so many things, it comes down to a question of love – love for the problems, for the field, for the artists and the artwork that are impacted and are bettered through our labors. For the colors.
- And make no mistake – those labors are first and foremost labors of love

Thank you.