MATERIALS INFORMATION and TECHNICAL RESOURCES for ARTISTS

ASTM and Lightfastness of Media

American Society of Testing and Materials (ASTM)

In an attempt to bring order to the wide variety of information provided by art material manufacturers, ASTM International (formerly the American Society of Testing and Materials) formed a subcommittee on Artist Paints and Related Materials (D01.57) affiliated with its committee on Paint and Related Coatings, Materials and Applications (D01). The members of that subcommittee developed standards that describe labeling, composition, physical properties, performance requirements, and methods for testing pigments, vehicles, and additives.

Lightfastness of Media

Several ASTM standards pertain to lightfastness:

- ASTM D5383, "Standard Practice for Visual Determination of the Lightfastness of Art Materials by Art Technologists"
- ASTM D5398, "Standard Practice for Visual Evaluation of the Lightfastness of Art Materials by the User"
- ASTM D4303, "Standard Test Methods for Lightfastness of Colorants Used in Artists' Materials"

Four test methods were chosen to accelerate the effects of long-term indoor illumination on artists' paints:

- Method A- exposure to natural daylight filtered through glass
- Method B- exposure to irradiance from daylight fluorescent lamps
- Method C- exposure in xenon-arc irradiance simulating daylight filtered through glass
- Method D- exposure to irradiance from cool white fluorescent lamps and soda-lime glass filtered fluorescent UV sunlamps.

Under these standards, lightfastness categories are assigned based on the color difference between samples before and after exposure to light as measured with a spectrophotometer. There are five categories which are expressed in terms of units of ΔE (Delta E)*ab -- the difference between two colors in an L*a*b* color space:

- **Lightfastness I:** Excellent Lightfastness (exhibits a mean color change of less than 4ΔE*ab)
- **Lightfastness II:** Very Good Lightfastness (exhibits a mean color change of more than 4.0 but not more than 8.0 ΔE*ab)
- **Lightfastness III:** Fair Lightfastness (exhibits a mean color change of more than 8.0 but not more than 16.0 ΔE*ab)

- **Lightfastness IV:** Poor Lightfastness (exhibits a mean color change of more than 16.0 but not more than 24.0 ΔE*ab)
- **Lightfastness V:** Very Poor Lightfastness (exhibits a mean color change of more than 24.0 ΔE*ab)

Certain manufacturers may provide information about "permanence" rather than lightfastness, or use proprietary terminology, symbols, and reference scales. Unless specifically started, do not assume that these ratings correlate with ASTM standards.

For example, some companies only use a system based on three categories that rates materials for permanence:

- Lightfastness I: Excellent lightfastness. The materials will exhibit no appreciable color change after being exposed to the appropriate equivalence of 100 years of indoor museum lighting. These materials are suitable for works that will be installed outdoors.
- Lightfastness II: Very good lightfastness. These materials are suited for indoor exposure, but should not be used for works that will be installed outdoors and receive heavy exposure to ultraviolet ligh.
- Lightfastness III: Marginal permanence. These are "fugitive" materials that are not recommended for permanent works.

Art material manufacturer websites are an excellent resource for information on lightfastness as an increasing number of companies are now publishing the lightfastness results of their products based on the tests outlined above.

It is important to note that the lightfastness of a particular pigment can differ with the vehicle used. For example, Vermilion has a lightfastness rating of I (excellent) when mixed in oils and acrylics. However, in a watercolor vehicle, it has a rating of III (fair). For this reason, one should check the lightfastness rating for both the specific manufacturer and the medium.

One should always check the label on a tube or jar to see if the generic names of the pigments are used and if the manufacturer certifies that the paint conforms to a standard and lists the lightfastness rating of the paint. Mark Gottsegen's book, "The Painter's Handbook, " contains additional information relating to ASTM standards as well as helpful tips on how to read the material listed on paint tubes (pg 152.).

Performing a Lightfastness Test at Home or in the Studio

As standards for rating lightfastness become defined for a wider range of art materials, more information is becoming available. However, lightfastness ratings are not easily accessible for all materials and brands.
There are ways to test the media you may already have and/or use. Some artists choose to carry out these tests simply to verify the ratings that a manufacturer has published. Home or studio testing of the lightfastness of media will not provide the

degree of accuracy that a lab provides, but it can be a worthwhile venture. There are two tests that can be carried out at home: a simple lightfastness test and a Blue Wool Standard lightfastness test.

In a simple lightfastness test, samples of a chosen material are prepared and exposed to natural daylight for several months, while a control sample is kept away from all light. The Blue Wool Standard lightfastness test exposes a set of dyed blue wool samples with known properties (Textile Fading Cards) to light alongside prepared samples of the material being evaluated. Each blue wool sample has a different rating. The ratings are: 1 = Very poor (fugitive), 2 - 3 = Poor (fugitive), 4 - 5 = Fair (impermanent), 6 = Very Good, 7 - 8 = Excellent.
As soon as a visible change occurs in the exposed area of that blue wool sample, the light exposure has reached the level it is rated. When the material being tested begins to show visible changes it is compared to the corresponding area of visible change on the samples of the scale, and is given a lightfastness rating.
ASTM standard D5398, "Standard Practice for Visual Evaluation of the Lightfastness of Art Materials by the User," uses Blue Wool Textile Fading Cards and is available for purchase at http://www.astm.org/Standards/D5398.htm. Detailed descriptions of procedures for both tests can also be found in *The Painter's Handbook* (Gottsegen) and at the following website:
http://www.handprint.com/HP/WCL/pigmt9.html.

A Guide to Selecting Other Types of Stable Media

At the present time, art materials manufacturers are not legally required to comply with ASTM quality standards. Compliance is voluntary. Manufacturers are legally obligated to conform to D4236, that provides labeling of hazardous materials guidelines and overall product labeling. It is very easy to determine which manufacturers are compliant, as the label on a compliant product will contain a conformance standard number for artists' quality products as well as information that indicates conformance to D4236 that include the common name of the color, pigment name, lightfastness rating, health certification, warning and handling information (if needed).

Charcoal and Graphite

These materials are carbon-based and should be very stable. However, binders or proprietary additives can affect the purity of the finished product. For this reason it is best to check the manufacturer's lightfastness ratings or perform a blue wool standard lightfastness test.

Pastel

The lightfastness of a pastel is dependent upon the pigment(s) used in the formulation, as a pastel contains very little binder. The biggest threat to works created with pastels is the friable nature of the medium and that certain fugitive dyes maybe present. Pastels have the tendency to be powdery or crumbly and

therefore easily smeared or dislodged from the paper surface. ASTM standards are being created for pastels. In the meantime, an increasing number of manufacturers of pastels list lightfastness information on their websites.

Watercolor
In general, watercolor paints are more susceptible to deterioration by light than other types of paints made with the same pigments. This is largely due to differences in the binder, as the binders in oil and acrylic paints provide a small amount of protection against fading due to their viscosity. Additionally, the thin layers in which watercolors are usually applied make them especially vulnerable to light damage.

Colored pencils
Colored pencils have their own standard, ASTM D6901, which provides a lightfastness test method and quality labeling information. Not all manufacturers adhere to this standard, but those who do post this information on their website. Some brands (e.g. Caran D'Ache, Prismacolor) have special ranges of colored pencils which are designed to be lightfast. If unsure, perform a blue wool standard lightfastness test.

Technical and Ballpoint Pen Ink
Most commercially available ballpoint and drawing pens are dye-based and have poor lightfastness. However, several manufacturers (e.g. Sakura, Sharpie) produce pigment-based ink pens which have superior permanence and appropriate lightfastness ratings. These come in a range of colors and tip widths. Testing should be done if these products are intended to be displaying in environments with high light levels.

Liquid Ink
Traditional India (or Chinese) ink is composed of a carbon-based black pigment mixed with water and a binding agent such as gelatin or shellac. Black or colored liquid inks can be made with dyes or pigments. Ink made with pigments tends to be more lightfast and indelible than ink made with dyes.

Felt-tip Pens and Markers
If felt-tip pens and markers are used to create artworks, prolonged exposure to light must be avoided in order to extend the life of the object. Most dye-based marker ink is inherently acidic and will fade when exposed to light. Dye-based markers labeled "permanent" are not lightfast – this designation means that the ink is indelible in water. "Archival" markers and pens contain pigments rather than dyes and are acid-free. However, they still have limited lightfastness. The recently introduced Winsor & Newton Pigment Marker claims to offer up to 100 years of lightfastness. (http://www.winsornewton.com/na/pigment-marker)

Dye-based Inkjet Prints

Dye-based inkjet inks are comprised of dye suspended in water with a solvent (glycol or glycerin) added to control drying time and thickness and proprietary materials added to control ink-drop formation, pH level, and lightfastness. Dye-based inkjet inks are extremely fugitive when exposed to light, sensitive to water and humidity, and vulnerable to environmental gasses.

Pigment-based Inkjet Prints
When pigment-based inkjet inks are used in combination with the proper paper, inkjet prints can last for years. Permanence tests on various combinations of ink and dye on specific printing papers and substrates are available on the Wilhelm Imaging Research, Inc website: www.wilhelm-research.com.

ADDITIONAL RESOURCES AND REFERENCES

ASTM Standards and Lightfastness

A Narrative Summary of ASTM International Standards Pertaining to Artists' Coloring Materials http://www.astm.org/COMMIT/D01_MSkalkaVersion_Final.pdf

Golden Artist Colors - How to Test For Lightfastness
http://www.justpaint.org/how-to-test-for-lightfastness

ASTM standard D5398 - *Standard Practice for Visual Evaluation of the Lightfastness of Art Materials by the User* (Uses Blue Wool Textile Fading Cards and is available for purchase) http://www.astm.org/Standards/D5398.htm

The Painter's Handbook: Revised and Expanded by Mark David Gottsegen (New York: Watson-Guptill, 2006), pp. 140-150.

Handprint - Doing Your Own Lightfastness Tests
http://www.handprint.com/HP/WCL/pigmt9.html

ASTM D4303-3 - Standard Test Methods for Lightfastness of Colorants Used in Artists' Materials http://file.yizimg.com/175706/2012070611140057.pdf

Labeling

Handprint - Labeling, Lightfastness & Toxicity
http://www.handprint.com/HP/WCL/pigmt6.html

The Painter's Handbook: Revised and Expanded by Mark David Gottsegen (New York: Watson-Guptill, 2006), pp. 151-2.

Lightfastness and Other Properties of Specific Media

University of Illinois at Urbana-Champaign – Inks and Other Media
https://psap.library.illinois.edu/format-id-guide/inkothermedia

Colored Pencil Society of America - About Lightfastness (Colored Pencils)
http://www.cpsa.org/cp-product-info/about-lightfastness

BonJet – Inkjet Prints http://www.bonjetmedia.com/en/technology/longevity

Western Association for Art Conservation Newsletter - Creating Long-lasting Inkjet Prints http://cool.conservation-us.org/waac/wn/wn28/wn28-1/wn28-106.pdf

Northeast Documentation Conservation Center - Creating Long-lasting Inkjet Prints https://www.nedcc.org/free-resources/preservation-leaflets/5.-photographs/5.4-creating-long-lasting-inkjet-prints

The Digital Print: Identification and Preservation by Martin C. Jürgens (Los Angeles: Getty Publications, 2009)