

METAMERISM

Color consistency is a critical requirement in architectural coatings, particularly when coatings are applied across large surfaces, multiple batches, or different substrates. In some cases, a color may appear to match perfectly under one light source but appear noticeably different under another. This phenomenon is known as metamerism.

Metamerism can create challenges during color matching, specification approval, and field application. What appears to be a successful match inside a store or under indoor lighting may look different when viewed outdoors or under alternate lighting conditions. Understanding the causes of metamerism and how to minimize its occurrence helps ensure consistent color performance in architectural coatings.

Understanding Metamerism

Metamerism occurs when two colors appear identical under one lighting condition but appear different under another. This happens because the colors may have different spectral reflectance curves, even though the human eye perceives them as the same under certain lighting. In architectural coatings, metamerism most often occurs when color matches are created using different pigment combinations that visually match under one light source but respond differently to changes in illumination.

Below are the reflectance curves for incandescent and daylight. Notice how incandescent has a lot of energy in the red area, but not much in blue. Because of the increased energy in the red area, objects illuminated by incandescent lighting appear redder than those under daylight, which peaks in blue (Figure 1).

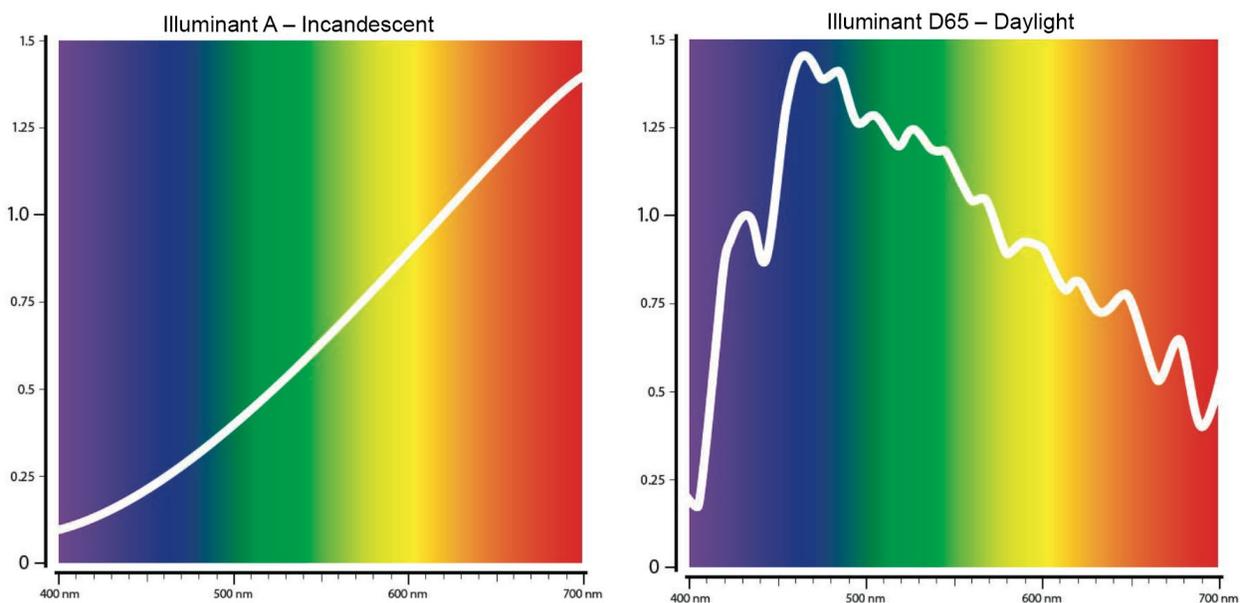


Figure 1

Several forms of metamerism can affect architectural coatings and color matching.

- **Illuminant Metamerism:** This is the most common form encountered in coatings. It occurs when two colors match under one light source but differ under another due to the spectral composition of the light. Different light sources emit different wavelengths of light, and because pigments reflect light differently across the visible spectrum, a color match that appears acceptable under one type of lighting may shift under another (Figure 2).

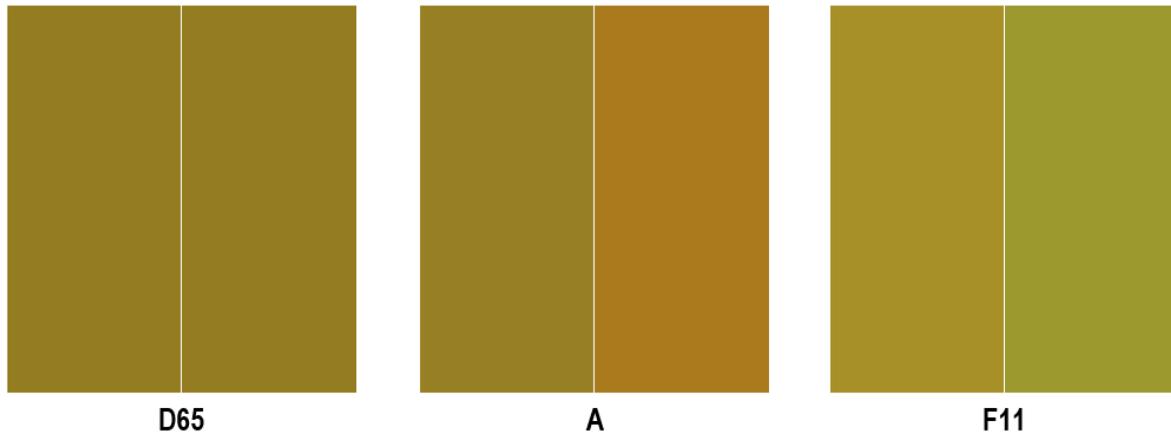


Figure 2. This set of three photographs shows color samples A and B mounted side by side under different lighting conditions. The first image is illuminated with daylight (D65), the second with incandescent light (A), and the third with a fluorescent source (F11). Under D65 the samples appear to match, but under A and F11 a noticeable color difference becomes apparent, demonstrating metamerism.

- **Observer metamerism:** This form of metamerism occurs when two individuals perceive the same color differently due to variations in human vision. Small differences in the sensitivity of the eye's photoreceptors can lead to differences in perceived color. This issue may be further exacerbated when one or more observers have a form of color vision deficiency, commonly referred to as color blindness. Because color blindness can affect how certain hues or color differences are perceived, it may increase the likelihood of disagreement when evaluating a color match. Several forms of color blindness exist, with red-green deficiencies being the most common, although blue-yellow deficiencies and other less common visual differences can also occur. Although observer metamerism is less commonly discussed in coatings than illuminant metamerism, it can still contribute to differing opinions about whether a color match is acceptable.
- **Geometric Metamerism:** This metamerism occurs when color appearance changes depending on viewing angle or surface orientation. This effect can occur when coatings contain pigments or additives that alter light reflection characteristics. In architectural coatings, this effect may be noticed when comparing flat surfaces to angled surfaces or when viewing coatings from different directions.
- **Field-of-View Metamerism:** This metamerism occurs when color perception changes based on the surrounding environment or adjacent colors. Large surfaces, lighting intensity, and surrounding architectural materials can influence how a color appears. For example, a color chip may appear slightly different when viewed on a wall compared to when it is viewed in isolation.

Why Metamerism Occurs

Several factors contribute to metamerism in architectural coatings. The primary cause is the use of different pigment combinations, since two formulas may produce the same visual color while relying on pigments that reflect light differently across the spectrum. Lighting differences between the store, the jobsite, and the finished environment can also play a major role in how color is perceived. In addition, substrate type and sheen can influence how light is reflected from the coating surface, with glossy finishes reflecting light differently than flat finishes and therefore altering apparent color. Film thickness and application method may further affect color appearance by changing the way light interacts with the coating film.

Minimizing Metamerism in Architectural Coatings

Although metamerism cannot be completely eliminated, several practices can significantly reduce the likelihood of noticeable color shifts.

1. Evaluate Colors Under Multiple Light Sources - Color approvals should ideally be evaluated under several lighting conditions. Viewing samples under multiple light sources helps identify potential color shifts before application.
2. Maintain Consistent Film Build - Changes in sheen level or film thickness can influence color perception. Maintaining consistent application practices helps ensure uniform color appearance across the project.
3. Prepare Proper Field Samples - Large drawdowns or jobsite mock-ups provide a more accurate representation of how the color will appear in the actual environment. Small color chips may not always reveal subtle metameric shifts.

How Vista Paint Mitigates Metamerism

Vista Paint employs several strategies to reduce the likelihood of metamerism in its color formulations and to improve overall color consistency. One important part of this process is the use of advanced color-matching technology, including spectrophotometric measurement systems that analyze the spectral reflectance characteristics of color standards. This allows Vista Paint to identify pigment combinations that more closely replicate the target color across a broader range of lighting conditions. In addition, Vista Paint prioritizes stable pigment/colorant combinations with consistent spectral performance when developing formulas, helping preserve color integrity and reduce the risk of unwanted shifts under different lighting environments. Unnecessary pigment substitutions are minimized, and the company's tinting systems are designed to provide repeatable, controlled colorant loading, which helps reduce variability from batch to batch. These efforts are further supported by routine quality control and batch verification procedures, during which color standards are checked throughout production to confirm that finished products remain within acceptable color tolerance ranges and maintain uniformity across manufacturing batches.

Practical Considerations for Architects and Contractors

Even with modern color matching technology, some degree of metamerism may still occur. Architects, specifiers, and contractors should consider the following best practices:

- Evaluate color selections under lighting conditions similar to the final installation environment.
- Review larger painted samples rather than relying solely on small color chips.

- Use the same manufacturer and coating system across all areas where color consistency is critical.
- Ensure that coatings are applied according to recommended film thickness and sheen specifications.

These practices help reduce the likelihood of unexpected color differences after project completion.

Key Takeaways

Metamerism is a natural optical phenomenon that can influence how architectural coating colors appear under different lighting conditions. While it cannot be completely eliminated, careful pigment selection, controlled tinting systems, and proper color evaluation practices can significantly reduce its impact.

Through the use of advanced color measurement technology, carefully selected pigment systems, and strict quality control procedures, Vista Paint works to minimize metamerism and maintain consistent color performance across its product line. By understanding how metamerism occurs and applying best practices during color selection and application, architects, specifiers, and contractors can achieve more reliable and visually consistent results in architectural coating projects.

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