Color Rendition, Flare, Color Constancy/Inconstancy, and Metamerism

Perhaps the biggest concern in industrial color matching is to produce a sample that matches the standard well regardless of viewing conditions. A "perfect match", visually and instrumentally, is an almost impossible goal to achieve. The variances in color match quality away from being "perfect" have a variety of terms that need to be understood.

Color Rendition: This is a visual assessment. The CIE defines it as:

The effect of illuminant on the color appearance of objects by conscious or subconscious comparison with their color appearance under a reference illuminant.

Viewing a colored object under an illuminant/source in a light booth, for example, will give you a color perception for that object. If you switch from that illuminant/source to a different one, a perception of if and how that object's color appearance has changed would be an example of color rendition.

Flare: This is a visual assessment and is just about the same as Color Rendition. Usually, this term used when the object's apparent color changes dramatically going from one illumination condition to a different illumination condition.

Color Constancy/Inconstancy: These terms can be considered two sides of the same coin and related to color rendition. It describes, either visually and numerically, the tendency of the object's color to stay the same (or to change) if the level and/or color of illumination changes for visual assessments or there is a change of illuminant used in the numerical assessments. Numerical assessments of constancy/inconstancy can be calculated from their colorimetric data comparison. For example, calculate a single colored object's CIELAB data under D65/10 and then again under F2/10. Calculate the color differences between the two as the constancy/inconstancy measurement.

Metamerism: This can be described both visually and numerically. As with all the previous terms, it is used to describe changes observed when an evaluation condition such as illumination changes, but metamerism is used when describing that change's effect on the apparent color relationship between two samples.

Under one set of circumstances, let's say viewing under cool white fluorescent lighting, two objects visually appear to be very close to each other in color ("a good match") and when their colorimetric values are calculated under the illuminant F2 (cool white fluorescent), their colorimetric differences (e.g., DL*, Da*, Db*, DC*, DH*, DE*) are small or near zero ("a good match").

Change to another illumination, say daylight, and visually they are no longer very close; their color relationship has noticeably changed from that under cool white fluorescent illumination. Similarly, when their colorimetric differences are calculated under F2, the color differences for their colorimetric data changes. In this situation, they are deemed both visually and numerically no longer to be a "good match". This is an example of illuminant metamerism. In this situation, if this were the best the color matcher was able to attain with his materials and process and was acceptable, this could be termed a conditional match.

All of the above terms have their basis for their behavior in the composition of the samples. Some colorants have more color inconstancy or flare than others. In the case of metamerism, a “non-metameric match” would be one where the composition of the two samples are virtually identical. In that case, both samples, regardless of the visual assessment conditions or the choice of illuminant, would continue to be a “good match”; even if there is a marked amount of color inconstancy or flare evident, both samples would shift in color appearance and measurement in identical directions.