Color is one of the most important qualities of both industrial and consumer goods, and designers, researchers, and manufacturers put immeasurable thought into the ideal pigmentation of products across industries. However, color is only one factor in the determination of a product's look; the final appearance of a product is the result of its chromatic qualities combined with the geometric attributes—or physical properties—that inform the specific way color is perceived by the viewer.[1] Geometric attributes can be vital to the functionality of a product, as well as critical to giving a product its desirable aesthetic appearance. However, these physical qualities can also present challenges to color matching when components with different geometric qualities must appear to be the same color. Gloss is perhaps the most common geometric attribute that manufacturers must account for. It can pose significant problems for color matching, as differences in materials can produce drastically different visual results, even when two objects have identical pigmentation.

## How Gloss Works

When light hits a glossy object, specular light—perceived as white light—reflects away from the surface, allowing the color of the object, or diffuse reflectance, to be concentrated without white light interspersion. The glossier an object is, the more specular reflectance is produced and the human brain discounts this specular reflectance as glare to focus solely on the pure diffuse reflectance. In contrast, when light hits a matte object, specular light combines with diffuse reflectance and acts to break up the intensity of the color as perceived by the human eye. As a result, high gloss objects will appear more colorful and darker while matte products look lighter and less saturated.[2] In many cases, this variation in light reflectance will result in two samples of the same color appearing to have different chromatic properties based on gloss level.

## RSIN vs. RSEX Measurements

Today's sophisticated spectrophotometers offer the best way of measuring the color of both glossy and matte objects and give users the option of either including or excluding specular reflectance data in the final color analysis of glossy samples. Reflectance-specular included (RSIN) mode will measure both specular and diffuse reflectance irrespective of surface conditions to produce a "true" quantification of color as a physical property. In this mode, two objects with identical pigmentation would have the same color values even if they displayed drastically divergent geometric attributes and were perceived as different colors to the human eye. While this is ideal for certain applications such as color formulation, it does not take into account surface conditions that can impact object appearance. Reflectance-specular excluded (RSEX) mode, however, excludes specular reflectance from its calculations to account for gloss and measure appearance rather than color alone. Two identically pigmented objects with different levels of gloss will therefore result in discrete color values. As such, this mode is preferable for those seeking to maintain consistency between objects with varying surface qualities and match the appearance of disparate materials.

## Choosing the Right Instrument

Diffuse d/8° sphere spectrophotometric instruments offer you a choice between RSIN or RSEX mode, but have inherent limitations when it comes to RSEX. In order to exclude spectral reflectance, a port on the sphere wall is opened to allow light to escape. While this works well for smooth, high-gloss surfaces, the limited size of the port presents problems for samples with lower gloss levels, as "the specular reflectance spreads over an angle greater than what can be completely excluded by the port opening. This presents a limitation in the ability of a diffuse sphere instrument to completely exclude all of the specular reflectance for all sample types."[3] For those wishing to employ RSEX measurement with these sample types or those who consistently want to exclude specular reflectance from color measurement, directional 45°/0° and 0°/45° instrumentation offers a superior alternative. Designed to mimic human vision, these spectrophotometers automatically work in RSEX mode and provide highly precise measurement of total object appearance, offering excellent color matching capabilities across samples with different geometric attributes.

Full article with photos available here:

https://www.hunterlab.com/blog/color-measurement-2/evaluating-spectrophotometric-solutions-for-color-matching-challenges-posed-by-gloss/