

Color Tolerance

Color and Color Tolerances in the Architectural Glass Industry

History

Because of natural changes in raw materials, every industry requires a quantitative system of measurement to insure that its products stay consistent from one batch to the next. Many techniques have been developed to measure color. Some set color chips use comparison while others use numerical data found from electronic equipment. In 1931, the CIE (Commission Internationale de l'Eclairage) created a method that allowed color measurement based on the perception of the human eye. Most modern color systems have adopted this data model.

Perception of Color

The intensity of specific wavelengths of light influences its perceived color. Light travels to the human eye by two means, light reflecting off an object and light transmitting through an object, which are perceived as the reflected and transmitted colors. Both of these types of light affect glass color. When a manufactured good must meet a particular color specification, the color system must compare data from the product to a static production standard. The variance between the two colors will determine whether the product is acceptable or if modification to its formula is necessary. The difference in color is referred to as the delta E. A determined value of Delta E is used as a guideline for mixing and re-matching colors.

Color Hindrance

When fabricating decorative glass, there are two ways in which the color is hindered. The first is the pigments present in the coatings applied to the surface of the glass. Pigments are typically mined materials and have inconsistent levels of impurities. These contaminants, even at very low levels, can change the color of a product enough to make it of unacceptable quality. Therefore, the producer must compensate by adjusting the amounts or the colors of pigments used. The second way in which color is hindered is by the color of the glass itself. The oxides used in manufacturing glass have the same traits as pigments, however, the colors are produced by a chemical reaction. During the manufacture of float glass, the hue is tested continually to ensure that it meets a specific range of color. If the contrast is too high, slight adjustments to the formula will shift it back to the center of the spectrum. Though the color will be acceptable, it is rarely identical. Compound effects from minute changes in both the glass substrate and the coatings applied challenge the final fabricator.

A common example of complications for a decorative glass manufacturer is the case when a paint color is matched too far in advance. Initially, the customer supplies a color chip to match. The producer will provide a sample that, when painted on the back surface of the glass, is as close as possible to the customer's request. When a job performs within a few months of sample approval, there is little chance that the company has replaced the materials used in making the sample. However, the longer time elapses, the more likely the materials will be of different hue, which necessitates adjustment to the color formula. This will ensure the new material on the new glass is comparable to the original mock up. This scenario is the norm for most industrial fabricators.

Conclusion

Every industry must alter their colors to keep within a dictated range. The paint supplier and the glass supplier go through the same process, as mentioned earlier. Unfortunately, some adjustments can make certain colors impossible to match a second time. For example, an off-white color matched on a piece of clear glass will be problematic because of the glass hue. From one crate to the next, the glass color can shift toward green at a delta E of 0.05. This very small change is tolerable by industry standards and undetectable to the human eye. However, when paint is applied to its surface, the color will appear grey. Any adjustment to the formula will make the color darker or push the delta E too far, causing an unsuccessful match. To avoid delays resulting from these deviations, the recommendation for all jobs requiring custom colors is a full size mock-up immediately prior to the job release.