https://doi.org/10.2352/ISSN.2169-2629.2017.32.289

The Manufacturing of a Color

Ann Laidlaw, ACL Color Consulting LLC (Decatur GA)

Abstract

The path of a color is described from the creative process through development, approval, and manufacturing. The use of robust standards and consistent procedures is crucial to managing accurate color with on-time deliveries, especially when products are fabricated from multiple materials.

Introduction

Color-accurate manufacturing requires careful attention to process and communication; before, during, and after the actual manufacturing. Many manufacturers have supply-chains that reach around the globe, requiring timely and accurate communication across time zones and multiple languages. Procedures must be communicated before the manufacturing order is placed, color evaluation must conform to the customer's requirements during manufacturing, and data may be reviewed after completion to inform customer on placing future programs aligned with the skills of specific factories.

Manufacturing color: start to finish

The color of a product may originate in any form of creative inspiration: the sky at sunset, a lush farm field, a retailer's visual display, or a competitor's hot-selling products are a few examples. Whatever the source, the creative inspiration needs to be translated into a robust color standard in order to achieve quality production.

What is meant by "robust color standard"? A color standard is used for both communication and evaluation of color products. The color standard will be the spectral data (reflectance curve) for instrumental colorimetry, and will be supported by physical specimens for visual evaluation. This is analogous to the use of CIE illuminants in instrumental colorimetry, and light sources which simulate the illuminants for visual colorimetry. Who controls the color standard? If the brand owner defers to the factory to manage the color, then the color may be tightly controlled across successive lots produced by that factory, but there may be distinct variation between different components that are to be fabricated into a single product. If the product if not multi-sourced, then the brand owner may find it advantageous to let the factory manage the color, and the factory color manager will be happy to use their own sample as a non-metameric standard for evaluating production. However, if the product is multi-sourced or contains multiple elements which are color critical, then the brand owner cannot defer to the various factories to manage color. All factories will need to evaluate their production compared to the color standard, which may be metameric to their item.

What is meant by "evaluation"? Color-critical products include a tremendous variety of items for consumers and commerce. Many products are composed of multiple components, including automotive, lingerie, and uniforms. Packaging and advertising colors are also crucial, albeit with different color difference tolerances than many products. Color evaluation may be executed instrumentally or visually, depending on the nature of the product or component. Evaluation is the process of comparing a sample (representing production) to the color standard determined by the customer. Whenever possible, the evaluation should be done instrumentally, using equipment and procedures that are aligned with the customer's quality requirements. These requirements are typically documented in color manuals which define sample presentation, temperature and humidity conditions of measurement laboratory, measurement geometry and software settings, and more. If a component or product is not suited to instrumental measurement, then it must be evaluated visually. However, items that are difficult to measure instrumentally are usually difficult to evaluate visually, also. Such items may feature glossy surfaces or irregular textures. The visual evaluation must be executed according to the detailed procedure provided by the customer. The procedure should include FM-100 color vision testing of all observers, specific class of light booth or luminaire, specific light source(s), and specific list of visual comments. Visual colorimetry requires training to achieve somewhat reproducible evaluations between observers and by a single observer and will result in more variation in color decisions compared to instrumental evaluation. Visual colorimetry also requires a physical color standard that is in excellent condition: not handled, correct temperature and humidity, and full size (not cut to share with other departments or sub-suppliers).

What are the tolerances for approval? Instrumental tolerances for color approval must be well-defined, using an ellipsoidal color difference metric (i.e. DEcmc or CIEDE2000). The tolerances may be set with separate boundaries for "pass", "fail", and "marginal". "Marginal" goods may be selectively used to fulfill orders or may be set aside for secondary review. Visual color evaluation also requires tolerances. Visual evaluators must be trained with physical examples of "pass", "fail", and "marginal" color differences. "Marginal" goods usually should be approved, and used strategically in fabricating products. Production goods may be "clustered" within colorspace for Best Practice.

Factories will often choose to develop the customer's color in a laboratory setting. While lab samples demonstrate capability to the customer, they offer the most value to the factory. This is the opportunity for the factory to determine which colorants and process to use to achieve a color when scaling up to production. In some industries, much effort and expense are spent in the effort to achieve satisfactory color on lab samples. However, since actual products are fabricated from production goods, not lab samples, this is a misplaced effort. The color quality of production goods must be monitored and evaluated.

Post-production data

The brand owner or customer has an opportunity to review color data post-production. The customer (or the factory) can use this review to optimize the allocation of goods to maximize first quality and to evaluate the success of this vendor for this program. Once a factory has demonstrated success in fulfilling specific programs, then the customer may choose to have that factory self-approve production goods, with oversight audit by the customer. In many supply chains, the factories are very

experienced with managing color successfully, and the customer would be wise to defer to the factory's expertise.

First quality manufacturing of color critical products starts with the color standard. The choice of standard can either minimize or exacerbate problems with color inconstancy of the product and metamerism among components. Factory production will be more consistent and more accurate when color development begins with a robust color standard, even without expenditures on equipment or training. In order for the manufacturer to execute his task correctly, the global color program needs to be aligned on lighting for visual and instrumental evaluation. This is an increasingly difficult task as new lighting technologies are installed in factories, offices, and retail spaces. In particular, LED sources offer myriad options in color temperature, spectral power distribution, and color quality. Customers or brand owners are responsible for educating themselves regarding appropriate specifications and for communicating this information throughout their supply chains.

Conclusion

Global color management programs start when the creative team hands off the color inspiration, and continue through delivery of goods into retail stores. The manufacturing process requires documenting all procedures and sharing the documentation with supply chain partners. Brand owners should also require periodic audits to confirm that factories are using correct equipment, following correct procedures, and correctly training their personnel. The goal of a global color program is for the brand owner to have the same confidence in color evaluations executed by supply chain partners as in evaluations conducted at the corporate site. People, equipment, procedures, and communication are the keys to a sound global color program.

Author Biography

Ann Laidlaw works with manufacturing and retail supply chain accounts at ACL Color Consulting LLC. She received her BS in Textile Science from Univ California, Davis, and MS in Color Science from Clemson University. Her industrial career includes X-Rite Inc, GretagMacbeth, SheLyn, and Burlington Industries. She is active in several color-related organizations, including ISCC, CORM, SPE, and DCC. She has served on ISCC, AATCC, and CORM Boards in the past, and currently serves as the ISCC Secretary. She is active in AATCC, and is a former chair of both the Color Measurement Test Methods (RA36) committee and the C2C (Concept to Consumer) Interest Group, and currently serves on the AATCC board. She received the ISCC Nickerson Award and the AATCC Chapin Award for service.

ACL Color Consulting LLC works with clients in various industries to manage, communicate, and control color for worldwide supply chain organizations.