



**A Guide to
Color Measurement and
Control in Plastics
Compounding and Molding**





**X-Rite Color
Measurement Products
Help You Formulate Color
and Keep Color Quality
Under Control**

The more discriminating consumers become about color, the greater the need for a means of measuring and describing color that eliminates individual human color bias.

For over two decades, X-Rite has been a world leader in the development and application of color measurement products providing accurate, predictable and consistent color data. These X-Rite products help you manufacture and formulate colors more efficiently and economically and keep color quality under control.

Meet the Most Demanding Color Quality Standards Every Time

X-Rite color measurement instruments and software are easy-to-use solutions designed to serve the color measurement needs of a broad range of industries and markets, including plastics processors, molders, extruders, resin manufacturers and consumers.

From color formulating to quality control, X-Rite color measurement products make it possible for manufacturers around the world to ensure that even their most demanding color quality standards are met.

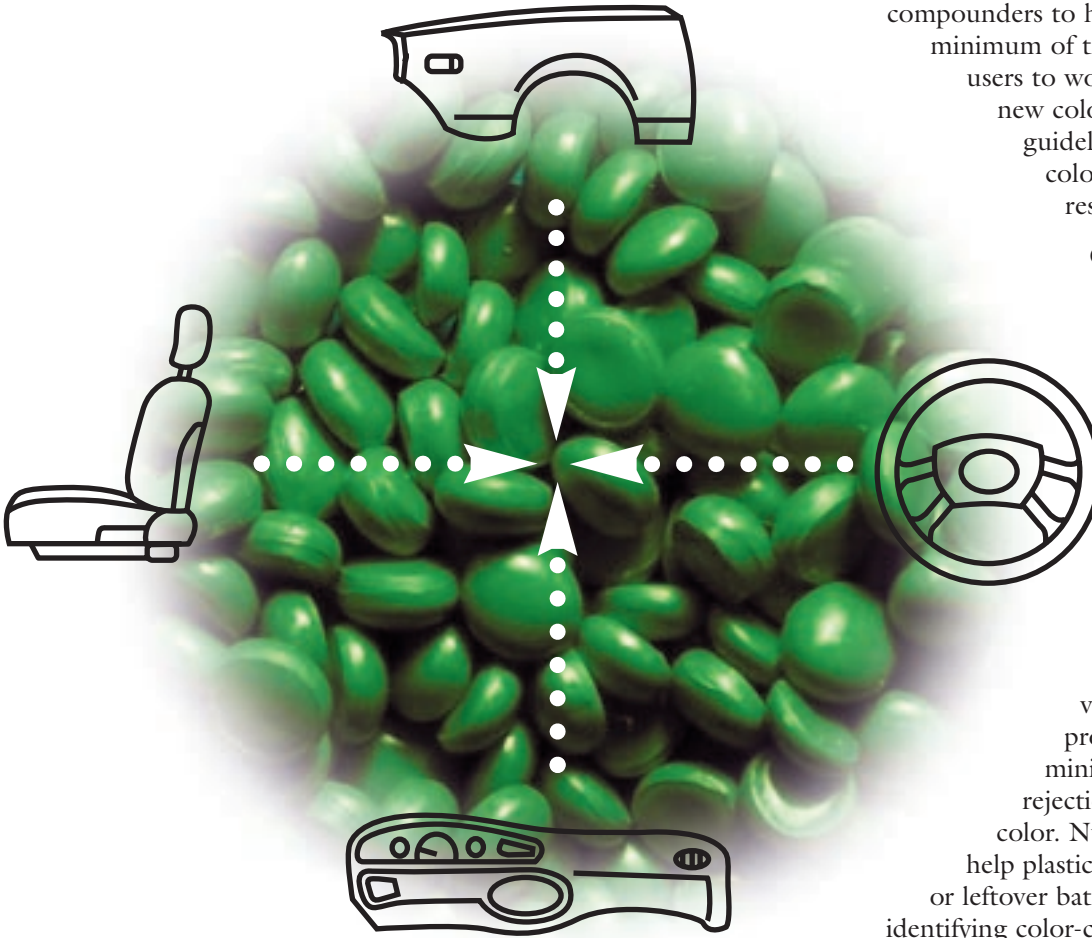
Where and How Numeric Color Control is Used in the Plastics Industry

The importance of precise color control is widely acknowledged today by formulation and quality control professionals throughout the plastics compounding and molding industry.

Formulation Applications — The benefits of numeric color control are obvious and, in most cases, significant. In formulating, for instance, the ability to control color permits compounders to hit target colors with a minimum of trial and error. It also enables users to work off surplus materials in new color batches by providing guidelines for achieving a desired color with available pigments or resins.

Quality Control Applications — Numeric color measurement plays an important role in quality control as well. It allows manufacturers to establish tolerances for acceptable color. This enables compounders and molders to check pigments, parts, components, and assemblies for conformance to color tolerance specifications. It also contributes valuable data to statistical process control systems, and minimizes the potential for parts rejection based on out-of-tolerance color. Numeric color control can even help plastics manufacturers work off odd or leftover batches of parts or assemblies by identifying color-conforming lots.

Establishing and maintaining color standards allows producers to match components manufactured at diverse locations, reducing labor and material costs associated with rejects and reruns. Quality control personnel in the automotive industry, for example, must ensure that the various textiles, plastics, vinyls, carpeting, and other materials used in a vehicle closely meet the designer's original color specifications and match when assembled together, regardless of gloss and texture.



Typical Plastics Supply Chain

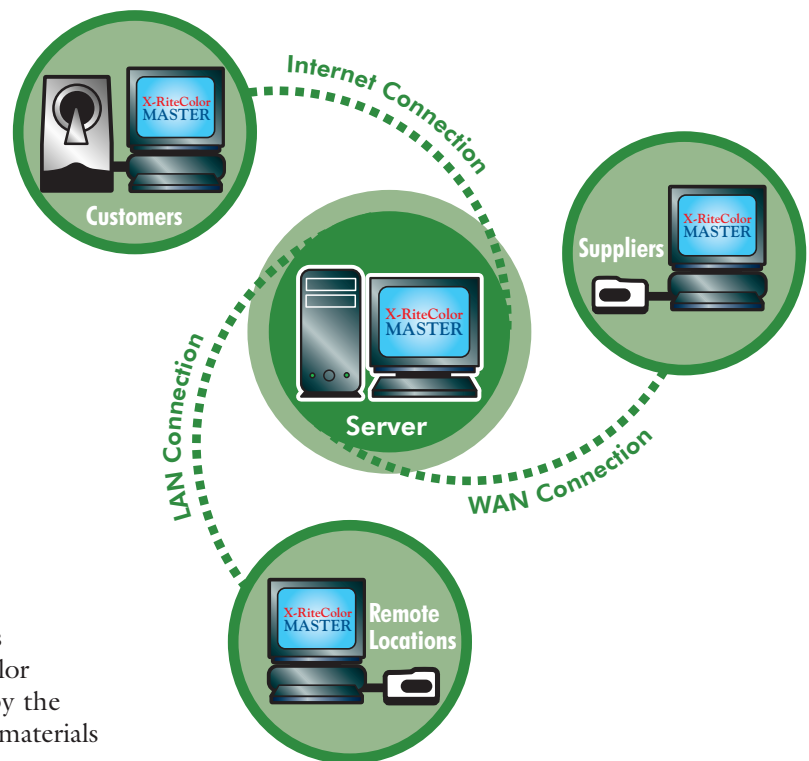


Total Supply Chain Color Control

Numeric color control plays a significant role in maintaining quality standards in an entire OEM supply chain. As the diagram above illustrates, the responsibility for color quality rests with several different suppliers in the plastics supply chain. Failure to maintain and meet precise color standards at any stage – from the pigment supplier to the resin/base supplier to the master batch supplier to the processor – can result in substandard quality in the end product.

This example illustrates why manufacturers are increasingly adopting a system of supply chain color management. Manufacturers can use X-Rite color measurement instruments and software to establish precise numeric color standards and deviation tolerances. Using the same types of instruments, suppliers can then measure and approve color at each stage of the supply chain, ensuring total color consistency and maintaining the manufacturer's established standards. Often, a supplier's initial color measurement equipment cost is more than offset by the elimination of a single rejected order of off-spec materials or components.

The inter-instrument agreement between individual X-Rite color measurement instruments and X-RiteColor® Master Web Edition lets manufacturers implement networking within a single plant or between plants to facilitate color data recording, precise color communication, and total color control for formulating and quality control. X-RiteColor Master Web Edition allows precise color data to be communicated instantly to any location in the world.



**Remove Subjectivity from Color Identification
by Measuring Wavelengths as Numeric Values**

The Science of Numeric Color Measurement and Control

It's impossible to understand how color can be measured, communicated and controlled without first understanding what color is. Because it is such a common element in our lives, most of us take color for granted. Yet, it is actually a complex phenomenon, one that's governed by the interplay of physics, physiology, individual experience and memory.

A Basic Definition of Color

In the simplest terms, color is the result of the interaction between light, an object and a viewer. The specific manner in which an object modifies light determines the viewer's perception of its color.

Objects can modify light in different ways. For example, solid objects reflect light, while transparent objects transmit it. What's more, light sources themselves are highly variable. Daylight, incandescent light and fluorescent light, for example, each consist of distinctive combinations of wavelengths. What we see as an object's color is actually an individualized response to a unique combination of light waves that it transmits and/or reflects. For example, a particular rose appears "red" when it happens to reflect the wavelength that is visually perceived and subjectively defined as "red" by the viewer — not because it possesses an innate and specific "redness" of its own.

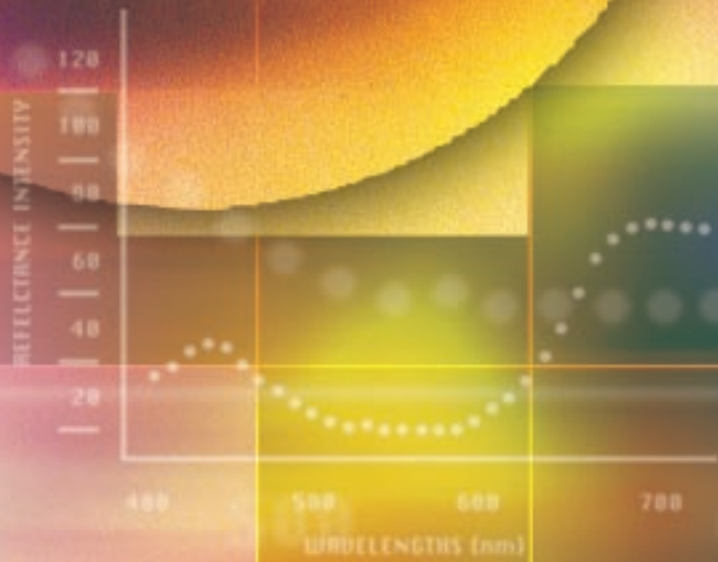
It follows from this definition that color is a partially subjective phenomenon of infinite variability. And it's precisely this variability that makes perception-based communication of color so difficult. That's why having an objective system for measuring and communicating color is so important.



ΔL° +0.09
 Δa° +0.59
 Δb° -0.54
 ΔE 0.80



A New, Universal Language of Color



X-Rite Color Measurement Products Remove Subjectivity from Color Identification by Directly Measuring the Light Waves that the Human Eye Visualizes As Color

The key to color control lies in the ability to measure color's basic structure—visual light waves—and arrive at absolute numeric values that allow us to assign precise identities to specific colors. This is an impossible goal without objective and highly accurate measurement devices.

The instruments receive color the same way our eyes do. They gather and interpret wavelengths of light that are reflected by an object. But, unlike a human viewer, when an instrument perceives color, it interprets the reflected wavelengths as numeric values absent individual human bias.

Numeric color measurement means everyone involved in the supply chain speaks a universal color language. This new language lets you compare a measured color to a pre-established specification. And that enables you to control the color—maintain it within acceptable tolerances—at every step in your production process or supply chain.

Great advances have been made in numeric color control since its inception. Today, X-Rite products measure, communicate, and help control color to a degree few thought possible. What's responsible for this new language of color? It starts with spectrophotometry.

The Power of Spectrophotometry

Spectrophotometers are the most accurate, useful, and flexible color measurement instruments available. They measure light reflected from an object at many points along the visual spectrum to produce spectral color data.

The two uncontrolled variables



components of color—the viewer and the light source—are controlled when spectral color data is recorded with an instrument. Spectrophotometers measure the composition of light before it is

interpreted by a viewer or device, and without regard to the ambient light source. The result is a set of reflectance values that are graphically interpreted in the form of a spectral curve. This curve is a highly precise color “fingerprint” that is the truest possible numeric representation of a color.

X-Rite's line of portable spectrophotometers includes a full range of color measurement options. For example, X-Rite multi-angle spectrophotometers are available to measure pearlescent, metallic and special-effect colors, and X-Rite sphere spectrophotometers accurately measure color surfaces of varying gloss or texture.

More information about the science of color, color communication, color measurement and color control is contained in X-Rite's comprehensive booklet, *A Guide to Understanding Color Communication*. For a free copy of this guide, call X-Rite at 1-800-657-0553 ext. 292.



X-Rite Products for Color Formulation and Quality Control

X-Rite color measurement products offer a variety of benefits. They allow formulators to obtain desired colors quickly, easily and with little waste. Quality control personnel can verify the color of raw materials, finished parts and assemblies to determine whether they meet established quality standards. Powerful system software allows you to compile detailed color reports to support internal statistical process control (SPC) programs, and to meet your customers' ISO 9000 and other reporting requirements.

X-Rite offers a complete line of color measurement products to support the plastics manufacturing process.

X-RiteColor Master Software

Windows-based, intuitive and easy to use. Available in two different versions.

X-RiteColor® Master Quality Assurance Software monitors and maintains color quality throughout the supply chain.

X-RiteColor Master Formulation Software formulates opaque, translucent and transparent colorants at fixed loads or with minimized pigment usage.

All X-RiteColor Master software is designed to work with X-Rite's portfolio of color measurement instruments.

Combining It All: X-RiteColor Master Web Edition combines all the features of X-RiteColor Master quality assurance and formulation software into a server-based computing environment.

X-RiteColor Master Web Edition software now resides on a central server located anywhere in the world. Users leverage the power of your existing intranet, LAN, WAN or Internet connections. They have access to global color standards and formulation data when they need it. Changes to software and standards are executed on the central server by qualified personnel, ensuring the entire supply chain is simultaneously updated. This eliminates the need for software to reside on individual and sometimes remote computers, saving time and money.

X-RiteColor Master Web Edition makes global color standards and reports a reality and paper-based reporting a thing of the past. Barriers such as time zones and languages no longer exist with X-RiteColor Master Web Edition because your server is running continuously, and seven languages are available with one mouse click.



Premier 8000 Series Benchtop

Ideal for quality control and formulation in the laboratory.

This high performance benchtop spectrophotometer offers transmission and reflectance measurement, horizontal and vertical positioning and built-in image capture technology. The 8000 Series features a sphere interior made of machined Spectralon®, a patented, rugged, scientific-grade reflectance material, not a coating. It won't corrode, flake or peel, eliminating the need for costly recoating.

Available in two models with varying price points and features sets.

TeleFlash™ System

Ideal for quality control in the color concentrate and resin manufacturing process.

This non-contact spectrophotometer offers automated color measurement on a moving sample. TeleFlash features color evaluation from up to five feet away, while generating a continuous color quality report. TeleFlash offers instant color deviation detection, eliminating the need for random samples to be brought back to the laboratory. This saves valuable time, money and expense.

SP60/62/64 Portable Sphere Spectrophotometer

Ideal for quality control for plastic processors, molders and extruders.

These portable sphere spectrophotometers are compact, rugged and lightweight ready for use on the plant floor. The SP60/62/64 series offers multiple measurement areas, opacity and color strength measurement and simultaneous measurement of specular component included and excluded. All three models feature patented Spectralon, a durable, highly reflective material designed to perform in a rigorous production environment. Available in three different models with varying price points and feature sets.

MA68II Portable Multi-Angle Spectrophotometer

Ideal for quality control for plastics processors, molders and extruders creating metallic, pearlescent and special-effect finishes.

This portable multi-angle spectrophotometer is compact, rugged and lightweight, ready for use on the plant floor. The MA68II offers five viewing angles (15°, 25°, 45°, 75°, 110°) allowing complete and accurate evaluation of changes in metallic, pearlescent and special-effect colors. X-Rite Dynamic Rotational Sampling technology utilizes a simple, robust optical system providing simultaneous measurement of all angles. The remote operation allows measurement data to be stored and downloaded to X-RiteColor Master software.





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