

# Color in Communication: Color Light Output White Paper

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*“Why do two colors, put one next to the other, sing? Can one really explain this? No. Just as one can never learn how to paint.” Pablo Picasso*

## Introduction

Pablo Picasso is only one of many who pay tribute to the importance of color. For designers and purchasers of products like cars, computers, and cell phones, color is a major consideration. Color is a critical element in the communication of information. According to an American Psychological Association study, *The Contributions of Color to Recognition Memory for Natural Scenes*, by hanging an extra “tag” of data on visual scenes, color helps us to process and store images more efficiently than colorless (black and white) scenes, and as a result, to remember them better. And when information is projected in business boardrooms and children’s classrooms around the world, color plays an important role in getting key messages across.

The data projector market has been in existence for more than two decades, with almost 60 million projectors sold for use in schools, theaters, homes and businesses. Yet, while superior image quality and brightness have consistently ranked at the top of buyer’s wish lists, there has been no standardized specification to measure the color performance of projectors.

Use of color can draw attention to important areas of text, a factor often critical in business and other presentations. Studies done by the Pantone Color Institute indicate that “consumers are up to 78 percent more likely to remember a word or phrase printed in color than in black and white.” Further, “When color is combined with the written word, it impacts readers with...greater recall, recognition and attention.”

Similarly, research conducted by Xerox in 2003 found that among business owners:

- 83 percent believe color makes them appear more successful
- 81 percent think color gives them a competitive edge
- 76 percent believe that the use of color makes their business appear larger to clients

Clearly, with color so important to effective communication, most people don’t need to be sold on the importance of Color Brightness in projected presentations. Yet while current specifications give information on brightness (or White Light Output), contrast ratio and resolution, they shed no light on a projector’s ability to reproduce and project bright, rich and accurate colors. Consumers, even sophisticated information technology buyers, have not until now had a metric to help them understand what they can expect their projector to provide in terms of color.

## A World of Color

Data projectors are no longer just a simple substitute for the venerable overhead projector, with its black lines and simple charts laid upon a transparency. Yet our thinking about the value of projectors, particularly in business and educational settings, has not advanced far beyond that.

To many, the words “projector” conjures up a dull presentation. But that’s an outdated mindset. What began as a tool for putting black and white words and simple color charts and graphs onto slides has evolved into a media-rich platform, supporting video, audio, animations and photographs. And presentation programs are just one paint source on the palette of choices business and education professionals can now use to tap into the power of color.

Indeed, nearly anything that a computer can store on its hard disk, play from its DVD drive or access from the Internet can be projected in living color. A short and not very exhaustive list would include online videos, corporate, educational and personal websites, personal and corporate blogs, short message feeds with photos, images from photo sharing sites, streamed full-length films and television shows, and many other sources.

Such rich, high-definition content has made the quality of the color produced by a projector extremely important, regardless of whether it is meant for home, business, or classroom use.

Considering this universe of color-based content, potential purchasers can evaluate projectors using a number of specifications. These include **white brightness**, **contrast ratio** (the difference between the brightest part of the image and the darkest), and **resolution** (such as XGA or SXGA, measured in pixels).

For most users, the key to determining the capability of a given projector to successfully present vibrant images is the projector’s brightness, measured in **lumens**. In general, the higher the number of lumens, the brighter the projector. One of the many reasons brightness is important in business and education projector is the frequent need to project in conference rooms and classrooms with the lights on.

Considering the overwhelming use of color in today’s presentations, the ability for a projector to project color at a brightness equal to its projection of white light is critical. Yet the widely-used lumens specification measures only white light, a fact unknown to more than 70 percent of projector buyers, according to a recent TFCinfo Associates study. And unfortunately, in more than 50 percent of projectors sold today, Color Brightness is substantially lower than White Light Output.

Even sophisticated information technology buyers often have no idea that the lumens specifications refer only to the output of white, rather than colored, light. Until the arrival of the new Color Light Output specification, buyers had no way to determine if a projector was capable of producing the bright, vivid color they demanded. In the digital era, where online ordering is the norm, the ability to evaluate the color quality of a projector on specs alone, without seeing it in action, is imperative.

## **The New Color Standard**

Faced with absence of reliable color information from projector users and purchasers, in 2009 the National Institute of Science and Technology (NIST) issued a scientific paper on Color Brightness. It stated that in addition to the typical white light brightness rating of display devices, there was a need to provide "an equivalent measurement that will better describe a projector's color performance when rendering full color imagery."

After extensive research and evaluation, the Society for Information Display (SID) concluded that a color brightness standard was relevant in the display industry. This scientifically valid measurement tool (referred to by the SID as Color Light Output), is designed to provide consumers with a specification to allow them to easily evaluate color brightness, a critical aspect of image quality.

The International Committee for Display Metrology (ICDM), a division of the SID, was tasked with developing the new standard. Composed of display experts, electrical, mechanical, software and optical engineers, physicists, vision scientists, and professionals in many display-related disciplines, the ICDM, along with the Video Electronics Standards Association (VESA) worked for two years to create the International Display Measurement Standard, or IDMS. Released in May, 2012, the comprehensive IDMS publication provides measurement methodologies for displays, including projectors, and for the first time, included Color Light Output.

Color Light Output (CLO), also known as Color Brightness, is a specification that provides information on a projector's ability to accurately reproduce color. Current brightness specifications only measure the total amount of white light projected, as stated in lumens. The new Color Light Output or Color Brightness specification measures red, green, and blue light, testing each on a nine-point grid, using the same methodology as that used to measure the brightness of white light.

The electronic version of the IDMS is available on the ICDM website (<http://www.icdm-sid.org/downloads/>) and includes test patterns, reporting templates, and other utilities for the new Display Measurement Standards.

## **Understanding Color Light Output**

Projector manufacturers typically provide information about resolution, White Light brightness and contrast ratio as metrics to define projector performance. But as none of these specifications directly address a projector's color performance, the Color Light Output metric complements existing specifications and gives buyers an accurate way to evaluate competitive models more thoroughly.

Measured using a similar approach to the tests for White Light Output, Color Light Output provides a simple, accurate and easy-to-understand metric to evaluate a projector's color brightness.

The traditional brightness (or White Light Output) specification measures the total amount of white light projected in lumens on a nine point grid, but *it does not measure color*.

To determine the Color Light Output of a given projector, three RGB (red, blue, green) color patterns are divided into nine separate areas. The luminance of the nine areas is then measured for each pattern, and an average value taken for each. Finally, the Color Light Output is calculated by adding the average values of the three patterns.

For optimal color performance, consumers should select projectors with specifications showing high Color Light Output, equal to the White Light Output. A high Color Brightness projector offering 3000 lumens of Color Light Output will also offer 3000 lumens of White Light Output. Projectors bearing a Color Light Output specification provide consumers with information on both White and Colored Light Output.

### **Color Light Output Key to Projector Purchase**

The importance of the new standard is shown in a recent study by the analyst group TFCinfo Associates, a leading strategic market research and publishing firm specializing in the audiovisual market. TFCinfo interviewed some 537 respondents purchasing projectors from leading retailers or respected internet sites.

The survey asked ten questions of these potential projector buyers. The results, as shown below, make it clear that color performance is a critical consideration in the projector purchase decision:

1. 86 percent of respondents projected color content
2. 89 percent said image quality is the most important factor in choosing a projector
3. 97 percent said brightness is the most important projector image quality specification
4. 99 percent said color is an important aspect of image quality
5. 79 percent of projector buyers thought color was part of the current (white) brightness specification
6. 79 percent of buyers expect the image quality of projectors to be comparable if similarly priced
7. 86 percent said Color Brightness is important when making a buying decision
8. 83 percent of buyers want Color Brightness information shown on the package and other materials
9. 91 percent said showing Color Brightness data would have a significant impact on purchase decisions
10. Buyers are willing to pay 19 percent more for projectors with higher Color Brightness

Many of the respondents were sophisticated buyers who purchase multiple projectors. Yet just 28 percent of such buyers surveyed on a leading projector website knew that the current brightness specification used in marketing projectors measures *only* White Light Output. Conversely, an overwhelming 72 percent of respondents believed, incorrectly, that the specification measured Color Light Output as well.

Once the respondents understood this, some 84 percent told the researchers that they want manufacturers to include Color Brightness, also measured in lumens, in projector specifications. And an overwhelming 94 percent of respondents stated that such a “Color Brightness specification” will have an impact on purchase decision. As Art Feierman, president of ProjectorReviews.com, notes, “Many projectors produce a hefty amount of white lumens, but come up very short when trying to produce rich, accurate colors.”

“We have been tracking end-user purchase criteria in the projector market for the last 10 years,” said Tanya Lippke, principal at TFCinfo. “In all market segments, from large corporations to education, image quality has consistently been the most important factor in selecting a projector. Twenty years ago, a typical projector presentation was text-based, usually plain black and white. Today, users demand high quality photos, graphics and video in their daily presentations, driving the demand for superior image quality.”

With the new Color Light Output specification, users will be able to quickly, easily and accurately evaluate color performance between competing projector models. A number of leading projector manufacturers, whose products are based on 3LCD technology, have adopted the new standard and will provide Color Light Output information on web sites, spec sheets, boxes and other marketing material for their projectors. If competitive projectors do not disclose their Color Brightness performance, Color Light Output can also be easily measured by end users themselves with a simple light meter.

Studies such as those done by TFCinfo consistently show that image quality is the number one attribute, and that brightness is the number one specification, called for by projector buyers. The new specification provides a standard, objective metric for unbiased comparison of projectors by Color Light Output. It also complements existing specifications, such as white brightness, resolution and contrast ratio, to give buyers a fuller picture of projector capability.

Leading manufacturers have already begun to implement a Color Light Output awareness campaign to better communicate the specifications of their projectors. Understanding color brightness will give users an easy, quick and accurate way to compare color between projector models and brands.

No longer do even the simplest presentations need to be drab. As Walt Disney might note, it’s a wonderful world of color.

#### *Author Background*

*Michael Goldstein was editor-in-chief of PC LapTop Computers Magazine, and technology editor of Successful Meetings and Presentations. He recently covered his 25<sup>th</sup> consecutive Consumer Electronics Show as a journalist.*