



# KA-07497\_Enhancing Color and Appearance Control in Industrial Coatings

## Introduction

In industrial coatings, color and appearance directly reflect manufacturing precision and end-use quality. Whether evaluating an epoxy floor system or a powder-coated machine housing, subjective color assessment leads to inconsistencies and costly rework. Instrumental measurement gives me a quantitative foundation for decision-making, ensuring that every batch meets color, gloss, and transparency specifications.

## Overview: Global Industrial Coatings Market

The industrial coatings market encompasses a diverse range of products—epoxy, polyurethane, acrylic, alkyd, and powder systems—designed to protect, decorate, and identify metal, concrete, and composite substrates. These coatings are used on heavy equipment, flooring, structural steel, and industrial machinery. Because many industrial coatings are applied in controlled facilities, integrating laboratory-grade instruments directly into QA workflows to monitor optical performance in real time is a significant advantage. Globally, increasing automation, customer color branding, and durability standards have made color and gloss traceability essential to maintaining both visual appeal and compliance.

## Importance of Color, Gloss, and Transparency



Industrial coatings often incorporate multiple layers: primers, pigmented bases, and clear topcoats. Color and gloss measurements verify that these layers collectively achieve target appearance and function. Gloss affects cleanability and perceived smoothness, while color stability reflects pigment dispersion, crosslinking, and cure uniformity. Transparent layers, such as epoxy sealers or UV-curable coatings, require clarity assessment to ensure visual depth and prevent haze buildup. Through measurement of CIELAB,  $\Delta E_{00}$ , gloss (GU), and haze (%), users can quantify all aspects of a coating's visual performance.

## What Color Reveals About Coating Quality

Instrumental color measurement exposes defects invisible to the naked eye:

- $\Delta L^*$  deviations can indicate improper mixing ratios or variations in dry film thickness.
- $\Delta a^*$  and  $\Delta b^*$  shifts reveal pigment instability, oxidation, or heat-related discoloration.
- In transparent films, increased haze signals micro-gellation or moisture contamination.

Tracking these metrics ensures consistent product performance while allowing early detection of supplier variability or environmental influence.

## Industrial Coating Applications

Industrial coatings include:

- **Epoxy floor systems** for warehouses, manufacturing, and cleanrooms.
- **Polyurethane or polyester coatings** for machinery housings and fabricated metal parts.



- **Powder coatings** for appliances, frames, and automotive subcomponents.
- **Clear topcoats and varnishes** that enhance durability while maintaining aesthetic clarity.

Each application demands reliable, reproducible color and appearance data—often under tight  $\Delta E_{00}$  tolerances ( $\leq 0.5$ ) and specific gloss windows ( $\pm 3$  GU) at  $60^\circ$  geometry.

## Challenges in Applying Color Measurement

Unlike decorative paints, industrial coatings often exhibit variable opacity, metallic content, or texture. These characteristics can complicate measurement, requiring geometry control and consistent film presentation. Measuring coated metal panels or textured epoxy samples demands uniform backing and illumination geometry. By using  $d/8^\circ$  integrating spheres (UltraScan VIS) for high-opacity finishes and  $45^\circ/0^\circ$  or  $0^\circ/45^\circ$  geometries (Agera, MiniScan 4500L) for visual correlation, users can capture color in both reflective and transmitted modes, ensuring accurate readings across materials.

## Global Standards and Methods

All appearance metrics in industrial coatings are standardized and traceable.

- **ASTM D2244** - Color difference calculation for CIE color coordinates.
- **ASTM D523 / ISO 2813** - Specular gloss measurement.
- **ASTM D1003** - Haze and transparency for clear films and coatings.
- **ISO 7724-1/2/3** -  $45^\circ/0^\circ$  measurement for color of paints and enamels.

Following these standards ensures uniformity across facilities, instruments, and production batches.



## Recommended HunterLab Solutions and Why

### UltraScan VIS - For Opaque and Transparent Coatings

The UltraScan VIS is a preferred laboratory reference instrument for industrial coatings. With  $d/8^\circ$  sphere geometry, SCI/SCE modes, and the ability to measure both reflectance and transmittance, it covers all coating types—from solid-color epoxy floors to clear varnishes. It reports full CIELAB and spectral data while quantifying haze, opacity, and transmission color (APHA, Gardner). This versatility makes it indispensable for characterizing coating systems that include clear primers, pigmented midcoats, and transparent sealers.

### Agera - For Color and Gloss in Production QC

Agera is excellent when gloss and color must be measured simultaneously. Its integrated  $60^\circ$  glossmeter and imaging capability correlate numeric  $\Delta E$  and GU values to surface texture and flow. This makes it ideal for controlling semi-gloss or matte industrial finishes and maintaining visual consistency across equipment housings and structural components.

### Vista - For Transparent Resin and Hardener Components

Vista quantifies the color (APHA) and haze of resin and hardener systems before blending, ensuring optical clarity and preventing downstream yellowing or cloudiness in clear epoxies or urethanes. It provides rapid transmission color data critical for incoming material QC.



## MiniScan 4500L – For On-Site Verification

The MiniScan 4500L offers handheld precision for verifying color consistency on large equipment or field-installed floors. Its 45/0° geometry matches the visual appearance of coatings as perceived by the human eye, making it invaluable for validating batch uniformity in real-world lighting.

## Instrument FABS Comparison Table

Instrument	Key Features	Advantages	Benefits to Industrial Coatings QA/QC
UltraScan VIS	d/8° geometry, SCI/SCE reflectance and transmittance	Measures opaque and clear coatings in one device	Provides full optical profile—color, haze, and opacity—for complex multilayer coatings
Agera	45°/0° geometry with integrated glossmeter	Simultaneous color and gloss measurement	Ensures consistent finish and appearance on pigmented coatings
Vista	Transmission sphere, dual detector	Quantifies color and haze of resins and solvents	Prevents yellowing and maintains clarity in clear components
MiniScan 4500L	Portable 45/0° handheld spectrophotometer	On-site color verification	Confirms batch-to-batch consistency on installed or large-format coatings

## Case Study – Epoxy Floor Systems (UltraScan VIS)

A manufacturer of high-build epoxy floor systems used in warehouses and cleanrooms faced recurring complaints about post-cure yellowing in clear coats and subtle color drift in pigmented gray layers. Visual inspection proved inadequate. They incorporated **UltraScan VIS** to measure both reflectance and transmittance properties of these coatings. Transmission measurements on clear resins established APHA ≤ 30



and haze  $\leq 1\%$ , while reflectance readings on pigmented coatings enforced  $\Delta E_{00} \leq 0.50$  and contrast ratio  $\geq 0.98$ .

Data revealed oxidation in stored hardener drums and blue-channel dips linked to under-applied film builds. These findings drove corrective action—supplier replacement of degraded material, tighter dry-film-thickness control, and the addition of UV stabilizers. Within months, yellowing complaints dropped 75%, and first-pass color acceptance rose from 92% to 99%. By integrating spectrophotometric analysis into their workflow, the company eliminated guesswork, reduced waste, and transformed color control from reactive inspection into proactive process management.

## Conclusion

Industrial coatings must perform in demanding environments while maintaining visual and functional integrity. Through precise color, gloss, and haze measurement, users can ensure consistent product appearance and performance across production batches. The combination of **UltraScan VIS**, **Agera**, **Vista**, and **MiniScan 4500L** provides complete analytical coverage—from liquid resin evaluation to final film verification—meeting ASTM and ISO standards and ensuring that every industrial coating meets its visual promise.