



# Enhancing Color and Appearance Control in Architectural and Appliance Coil Coatings

## Introduction

Coil coating combines continuous production speed with stringent appearance demands. Color differences of just  $\Delta E_{00}$  0.5 can result in customer rejections once panels are installed side by side. Instrumental color and gloss measurement transforms coil coating from a reactive inspection process into a predictive quality system. HunterLab spectrophotometers don't just detect variation, they quantify and control it in real time.

## Overview: The Global Coil Coatings Market

Coil coatings protect and decorate aluminum and steel coils used for building facades, roofing, garage doors, and appliances. Globally, coil coating volumes exceed 6 million tons per year, driven by architectural construction and durable consumer goods. In both markets, color uniformity is critical: building panels must match perfectly under daylight and artificial light, while appliance components—such as refrigerator doors and side panels—must align even across multiple suppliers. Maintaining visual harmony across production runs, lines, and plants depends on consistent, traceable color data.

## Importance of Color and Gloss Measurement



Coil coatings are complex, multi-layer systems: pretreated metal, primer, topcoat, and sometimes clear coat. Each layer contributes to the final appearance, so color and gloss must be managed at every stage.

- **Color** confirms correct pigment ratio, film thickness, and cure temperature.
- **Gloss** defines surface appearance—high-gloss appliance finishes vs. matte architectural textures.
- **Spectral reflectance** helps detect subtle hue shifts due to temperature or chemistry changes.

By measuring these parameters in the lab and inline, users ensure each coil's finish remains within tolerance from start to end of production.

## What Color Reveals About Coil Coating Quality

Color is a key diagnostic of process stability.

- **L\*** changes reveal over-bake or under-bake conditions.
- **a\*** and **b\*** variations indicate pigment degradation or crosslinker imbalance.
- **Gloss loss** signals contamination or uneven cure.

In the past, such issues were discovered after shipment. Now, real time color and gloss data helps to maintain both the target hue and surface appearance.

## Coil Coating Applications

1. **Architectural Panels and Roofing Coils** – Color stability across batches ensures seamless building facades.
2. **Appliance Coils** – Gloss and hue must match brand palettes precisely, even between metal doors and plastic trims.



3. **Industrial Panels and Doors** - Durable, weather-resistant coatings require tight  $\Delta E$  control through long production runs.

By measuring color continuously during coating and curing, users ensure reproducibility and eliminate costly post-production sorting.

## Challenges in Applying Color Measurement

Coil coating poses unique measurement challenges:

- **High-speed substrate movement** demands non-contact, high-frequency readings.
- **Specular reflection** can distort readings on glossy surfaces unless geometry and calibration are controlled.
- **Temperature fluctuations** during curing can induce spectral drift.

With inline **SpectraTrend HT** monitoring, users capture continuous reflectance data, correlating it with laboratory Agera benchmarks to maintain process alignment.

## Global Standards and Methods

Key standards that guide coil coating color control include:

- **ASTM D2244** - Calculation of color differences using CIELAB.
  - **ASTM D523 / ISO 2813** - Specular gloss determination.
  - **ASTM E1347** - Measurement of reflectance using spectrophotometers.
  - **ISO 7724-2/3** - 45°/0° geometry for color of paints and enamels.
  - **NCCA Technical Bulletin 404** - Coil coating color tolerances and test methods.
- Adhering to these standards ensures that I can compare results across facilities and suppliers with full confidence in traceability.



## Recommended HunterLab Solutions and Why

### Agera - For Lab Color, Gloss, and Imaging Analysis

**Agera** serves as the primary instrument for coil coating quality control. Its 0°/45° geometry matches human visual response, and its integrated 60° glossmeter simultaneously records gloss values during color measurement. This dual capability allows users to control both hue and finish from a single device. Its imaging feature helps detect surface flow or texture variations on test panels—a critical benefit for coil finishes where micro-texture affects gloss and light scattering. With repeatability of  $\Delta E < 0.02$  and gloss repeatability within 0.2 GU, Agera is ideal for reference testing, batch certification, and master standard creation.

### SpectraTrend HT - For Inline Real-Time Color Monitoring

On the line, **SpectraTrend HT** provides continuous, non-contact color monitoring. Mounted above the moving coil, it measures reflectance at intervals of less than a second, flagging deviations beyond pre-set  $\Delta E$  tolerances. This system enables users to detect drift during coil runs due to solvent evaporation, pigment feed fluctuations, or bake oven changes.

### UltraScan VIS - For Transparent Coatings and Ink Systems

For coatings incorporating transparent or semi-transparent layers—such as clear topcoats or protective varnishes—the **UltraScan VIS** provides both reflectance and transmittance data. It quantifies haze and transparency, ensuring visual depth and uniformity in metallic or clear-over-color coil systems.

### MiniScan 4500L - For Field and Off-Line Verification



In quality audits or customer complaint verification, the **MiniScan 4500L** handheld spectrophotometer measures panels directly at installation sites. Its 45/0° geometry replicates the visual perception of color differences and verifies that field panels match lab-approved standards.

## Instrument FABS Comparison Table

Instrument	Key Features	Advantages	Benefits
Agera	45°/0° geometry, integrated 60° glossmeter, imaging	Simultaneous color and gloss control	Ensures precise match of appearance and finish for architectural and appliance panels
SpectraTrend HT	Inline non-contact continuous monitoring	Real-time process feedback	Detects color drift instantly during coating and curing
UltraScan VIS	d/8° sphere, SCI/SCE, reflectance and transmittance	Measures opaque and transparent layers	Verifies color, haze, and opacity in multi-layer or clear systems
MiniScan 4500L	Portable 45/0° handheld spectrophotometer	On-site measurement correlation	Validates coil color and gloss consistency across production and installation sites

## Case Study - Inline Color Control in Coil Coating

During a major coil production run, the QA system flagged subtle hue shifts that appeared after several thousand feet of coated aluminum were processed. The **SpectraTrend HT** detected an upward drift in  $\Delta b^*$ , indicating a gradual yellowing trend. Visual inspection at this stage showed no obvious difference, but the data revealed early deviation.

The company evaluated the inline data to and found a  $\Delta E_{00}$  of 1.1—outside the  $\pm 0.8$  tolerance. Further investigation showed solvent ratio variation due to ambient



humidity changes. By adjusting the line temperature and resin mix ratio, they brought the process back into tolerance within minutes. The remainder of the coil run stayed within  $\Delta E_{00} \leq 0.4$ .

In the past, this type of deviation might have been discovered only after the coil was shipped and panels installed, leading to rework or warranty claims. With continuous color monitoring and lab correlation, the company prevented costly scrap and maintained uniform color across multiple coils destined for a commercial facade and appliance housing line.

## Conclusion

Architectural and appliance coil coatings demand perfection in color and appearance—where a tenth of a  $\Delta E$  can separate acceptable from rejected. Through integrated spectrophotometric control, users can achieve that precision. The combination of **Agera** for lab-based reference and gloss correlation, **SpectraTrend HT** for real-time inline monitoring, **UltraScan VIS** for layered and transparent systems, and **MiniScan 4500L** for field verification provides end-to-end color management. This approach ensures every coil—whether for a high-rise facade or a refrigerator door—meets the same visual and technical standard worldwide.