HunterLab Agera L2 Dark Performance Mode: Precision Color Measurement for the Darkest Materials

Many manufacturing environments involve materials with inherently low reflectance—deep chromatic plastics, low-gloss coatings, masterbatch, elastomers, specialty inks, and carbon-loaded compounds. Dark Performance Mode expands Agera L2's capabilities into the lowest reflectance ranges, enabling accurate, stable color measurement of deep blacks, navies, and saturated pigments that challenge conventional instruments.

Description

The HunterLab Agera L2 Dark Performance Mode is a specialized operating mode designed to deliver superior color accuracy, repeatability, and stability when measuring ultra-low reflectance samples—typically those below 15% reflectance. These materials often present unique optical challenges that exceed the limits of standard spectrophotometric systems.

Dark Performance Mode combines optimized illumination control, enhanced detector sensitivity, and advanced signal processing algorithms to maximize the signal-to-noise ratio (SNR) in dark regions of the reflectance spectrum. The result is true-to-appearance, visually correlated color data that allows manufacturers to measure, monitor, and manage the darkest materials with confidence and consistency.

Purpose

Color uniformity in very dark products is critical across industries—from ensuring batch-to-batch consistency in automotive coatings and black masterbatches, to maintaining the aesthetic quality of dark roasted coffee or cocoa powders. Traditional

spectrophotometers often struggle in this range, as stray light, detector noise, and surface irregularities can distort measurements.

The purpose of Dark Performance Mode is to eliminate these sources of error, enabling accurate, reproducible color data that supports:

- Process optimization and batch validation
- Visual correlation between laboratory and production environments
- Global quality standardization across supply chains
- Regulatory compliance and product traceability

Why Ultra Dark Samples Are Challenging

Ultra-dark materials reflect only a small fraction of incident light—often less than one-fifth of what a mid-tone sample reflects. This creates multiple challenges:

- Low Signal Strength: Minimal reflected light leads to higher susceptibility to electronic noise.
- Stray Light Sensitivity: Even small amounts of scattered or internal reflection can disproportionately affect results.
- Texture and Gloss Variability: Matte, semi-gloss, or uneven surfaces produce directional reflections that distort average readings.
- Detector Nonlinearity: Standard detectors may lose precision in the lower reflectance region, causing unstable ΔE values.

Agera L2's Dark Performance Mode directly addresses these issues by refining top of scale standardization, illumination intensity, optimizing detector gain, and employing algorithmic compensation for noise and scatter effects.

Technical Overview of Dark Performance Mode Operation

Dark Performance Mode integrates several hardware and software-level optimizations within the Agera L2 platform:

- Dynamic Illumination Control – The LED illumination system is adjusted to deliver stable, uniform light intensity at low reflectance levels without saturating the detector
- Enhanced Detector Gain & Filtering – The optical detector operates in a high-sensitivity range with digital noise filtering, preserving accurate signal response in the near-zero reflectance domain
- Normalized Wavelengths -all wavelengths are normalized to a 15% "virtual top-of-scale" reference. This expands the resolution, sensitivity, and usable dynamic range for very low-reflectance materials.
- Stray Light Reduction Optics – Internal baffling and coated optical surfaces minimize stray reflections that can skew readings on black or textured samples
- Visual Correlation Assurance – 0° illumination / 45° circumferential viewing geometry ensures the data aligns with human visual perception, even for textured, matte, or semi-gloss dark surfaces.
- Provides Ultra Dark ISO Compliant Industry Standard Indices: Blackness (My, Mc, dM), Greyness (Gy, Gc, dG).

ISO Conformance for Extremely Dark Samples

ISO 18314-3 defines standardized indices for describing the appearance of extremely dark materials—where traditional L*, a*, b* values do not provide enough sensitivity or visual correlation. These indices allow manufacturers to quantify how black, how neutral, or what undertone a dark material has using consistent, traceable methods.

1. ISO Blackness

ISO 18314-3 provides formulas for evaluating the depth and undertone of very dark samples:

- My (black value)
- Mc (color depending black value)
- dM (absolute contribution of hue)

These indices are widely used in automotive coatings, plastics, inks, and pigments when subtle undertone differences matter.

2. ISO Greyness

Greyness in ISO 18314-3 is a specialized index applied to black materials that do not behave like carbon-black-based jet blacks. It quantifies how much a black sample departs from ideal blackness (e.g., due to pigments, fillers, or surface scattering). It does not refer to general grey colors or neutral grey scales.

ISO 18314-3 also defines indices for describing how neutral a dark or grey material is:

- Gy (hue independent greyness value)
- Gc (hue independent greyness value)
- dG (absolute contribution of hue)

The common purpose of these indices is to quantify whether a material is close to a true neutral grey or whether it contains detectable chroma (e.g., a graphite grey that appears slightly green, blue, or red). These metrics are especially valuable for plastics, coatings, textiles, and other materials where neutral greys must remain visually consistent.

3. Why ISO Indices Matter for Ultra-Dark Measurement

ISO blackness and greyness indices become meaningful only when an instrument can reliably measure very low reflectance values. Without sufficient signal-to-noise performance, these calculations become unstable.

Agera L2 with Dark Performance Mode provides:

- High stability in the ≤ 15% reflectance region
- Lower noise and improved spectral precision
- Reliable inputs for ISO 18314-3 calculations

As a result, the instrument can report blackness and greyness with consistency suitable for production QC, supplier alignment, and color approval workflows.

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Applications and Industry Impact

Industrial and Coating Applications:

- Powder and Protective Coatings: Measures dark metallic or carbon-black-based coatings where gloss or surface texture can distort standard readings.
- Building and Construction Materials: Evaluates color stability of roofing granules, dark composites, and façade panels exposed to UV and environmental stress.

Plastics and Polymers:

- Black Masterbatches: Enables color matching and formulation verification in carbon-black and pigment-loaded pellets.
- Consumer Goods and Packaging: Maintains appearance uniformity in dark housings and enclosures across multiple suppliers.
- Automotive Interior Components: Ensures consistency across textured or molded surfaces with low reflectance values.

Textiles and Leather:

- Dyed Fabrics: Measures deep navy, charcoal, and black fabrics where gloss and weave affect visual tone.
- Synthetic and Natural Leathers: Provides stable readings on textured, matte, or embossed surfaces used in upholstery and apparel.

Chemicals, Minerals, and Powders:

- Carbon Black and Conductive Powders: Measures reflectance consistency in fine black particulates used in rubber, inks, and electrodes.
- Metal Oxides: Tracks production quality of iron oxide and manganese dioxide pigments used in coatings and catalysts.
- Battery Components: Quantifies reflectance of graphite, cathode, and anode materials for quality validation.

Pharmaceuticals and Cosmetics:

- Dark Tablets and Capsules: Ensures color uniformity in coatings containing iron oxides or natural pigments.
- Cosmetic Formulations: Enables precise tone control in mascaras, eyeliners, and pigmented creams where perceived depth defines quality.

Food and Beverage Applications:

- **Cocoa, Coffee, and Tea Powders:** Ultra Dark Mode quantifies roast and blend color to maintain sensory consistency.
- **Chocolate and Confectionery:** Ensures stable color and gloss balance in dark chocolate coatings and inclusions.
- **Spices and Dry Mixes:** Accurately measures paprika, black pepper, and activated carbon blends.
- **Processed Meats and Proteins:** Evaluates uniformity in dark-cured or roasted surfaces to ensure visual appeal and process repeatability.

Advantages of Dark Performance Mode

- **Enhanced Sensitivity:** Accurate readings below 15% reflectance.
- **Improved Repeatability:** Reduces ΔE variability caused by detector noise and surface effects.
- **Visual Correlation:** 0°/45° circumferential geometry matches human perception of dark tones.
- **Versatility:** Performs reliably across powders, solids, and textured surfaces.
- **Global Standardization:** Enables consistent quality control across worldwide production and supplier networks.

Conclusion

The Agera L2 Dark Performance Mode represents a major advancement in the instrumental color measurement of extremely low-reflectance materials. Agera L2 can report standardized blackness and greyness indices in alignment with ISO 18314-3, complementing traditional L*, a*, b* analysis.

By combining refined optical design with intelligent signal control, HunterLab has created a tool capable of translating even the darkest, most complex visual surfaces into stable, traceable, and actionable data.

Whether ensuring brand consistency in automotive interiors, validating pigment concentration in masterbatches, or quantifying roast color in coffee or cocoa, Dark Performance Mode extends the boundaries of color science—enabling manufacturers to achieve true visual correlation, global process alignment, and unparalleled confidence in dark color measurement.