



Antimony Color Measurement Methods

Standardized Procedures for Quality Control and Process Monitoring

Introduction

Color measurement of antimony materials provides a fast, objective, and reliable indicator of purity, oxidation state, and batch consistency. When implemented using standardized procedures and HunterLab spectrophotometers, color data becomes a powerful process control tool supporting tight tolerances, reducing variability, and protecting downstream product quality.

Because antimony materials vary significantly in physical form—from white powders (Sb_2O_3) to reflective metallic surfaces—measurement approach and sample presentation must be carefully controlled to ensure repeatable and meaningful results.

Purpose

This document defines standardized methods for measuring the color and appearance of antimony materials to support:

- Consistent, repeatable measurements across operators and sites
- Early detection of contamination, oxidation, or process variation
- Alignment between instrumental data and visual perception
- Scalable workflows from single-instrument QC to enterprise-wide quality management



These methods apply to:

- Antimony trioxide (Sb_2O_3) powders
- Metallic antimony (ingots, pellets, cast surfaces)
- Antimony-containing additives and intermediates

Key Principles of Antimony Color Measurement

1. Color as a Process Indicator

Color in antimony is not purely aesthetic—it reflects underlying chemistry and process conditions. Small changes in L^* , b^* , or whiteness can indicate:

- Oxidation or degradation
- Contamination (e.g., iron, sulfur)
- Process drift (temperature, atmosphere, formulation)

2. Material Form Matters

Antimony appearance varies by form:

- Metallic antimony: Silvery-gray, reflective, texture-dependent
- Sb_2O_3 powder: High-whiteness, fine particulate
- Compounds/additives: May shift from white to gray or yellow

Measurement strategy must align with these differences.

3. Geometry Selection is Critical

- $45^\circ/0^\circ$ (annular reflectance): Best for powders and visually correlated measurements



- d/8° sphere: Preferred for metallic or highly reflective, non-uniform surfaces

Important Notes

1. Powder Presentation Drives Repeatability

For Sb_2O_3 powders, consistency in fill depth, leveling, and preparation has a greater impact on results than the instrument itself. Oxidation or degradation

2. Metallic Antimony Requires Averaging

Due to surface variability, single measurements are not representative. Always measure multiple locations and evaluate both average and variation.

3. Color = Early Warning System

Color shifts often indicate process issues before they are visible or measurable by other means—use color proactively, not just for pass/fail.

Why Measure Color in Antimony?

Purity and Oxidation Monitoring

- Detect yellowing or darkening from oxidation
- Maintain high whiteness in Sb_2O_3

Product Quality Control

- Critical for flame retardants, plastics, and glass
- Direct impact on final product appearance and performance



Batch-to-Batch Consistency

- Ensures uniformity in masterbatch and additive applications
- Supports customer specifications and visual standards

Measurement Approach

Recommended Metrics

- CIELAB (L^* , a^* , b^*) (primary system)
- ΔE^* (difference vs standard)
- Whiteness Index (WI) - critical for powders
- Yellowness Index (YI) - early contamination indicator

Typical Expectations

- Sb_2O_3 : High L^* , low b^* (minimal yellowing)
- Oxidized material: Lower L^* , higher b^*

Measurement Challenges

1. Powder Variability

- Sensitive to packing density and surface uniformity
- Requires strict preparation consistency

2. Surface Effects (Metal)

- Reflectivity and texture introduce variability
- Requires averaging across multiple locations

3. UV Sensitivity



- Some systems respond differently under varying illumination
- Stable D65 + UV control improves visual correlation

4. Tight Tolerances

- Typical limits: $\Delta E < 0.5$ (often < 0.3)
- Requires high instrument stability and repeatability

Standardized Measurement Workflow

A. Sb_2O_3 Powder

Setup:

- Instrument: ColorFlex L2 or Agera L2
- Illuminant/Observer: D65 / 10°
- Metrics: L^* , a^* , b^* , ΔE , WI, YI

Procedure:

1. Prepare sample with consistent fill and leveling
2. Take minimum 3 replicate readings
3. Average results
4. Compare to approved standard

Key Rule: Consistency in preparation is critical for reliable results.

B. Metallic Antimony

Setup:

- Instrument: UltraScan VIS/PRO (preferred) or Agera L2



- Metrics: L^* , a^* , b^* , ΔE

Procedure:

1. Select representative surface areas
2. Measure 3-5 locations
3. Record individual values
4. Calculate average and variation

Key Rule: Evaluate both average color and uniformity.

Quality Control and Data Management

Recommended Workflow

Single-Site QC

- Use EasyMatch Essentials L2 for:
 - Fast pass/fail decisions
 - Standardized workflows
 - Reduced operator variability

Multi-Site / Enterprise QC

- Use EasyMatch Quality Central for:
 - Centralized standards and tolerances
 - Data synchronization across sites
 - SPC trending and audit traceability



Troubleshooting Overview

Issue	Likely Cause	Corrective Action
Poor powder repeatability	Inconsistent sample prep	Standardize fill and leveling
High variability (metal)	Surface non-uniformity	Increase measurement locations
Drift over time	Calibration or environment	Recalibrate, clean optics

Best Practice Summary

- Treat color as a process control tool, not just a specification check
- Standardize sample presentation to reduce variability
- Use appropriate geometry based on material form
- Focus on whiteness/yellowness for powders
- Apply replicate measurements and averaging for reliability
- Leverage centralized data systems for consistency across operations

Conclusion

Color measurement of antimony materials is a critical quality control function that extends beyond visual assessment. When implemented with standardized methods and appropriate instrumentation, it enables manufacturers to detect process variation early, maintain tight tolerances, and ensure consistent product performance across batches and sites.



By focusing on proper sample presentation, correct measurement geometry, and meaningful color metrics, organizations can significantly improve repeatability, reduce scrap and rework, and protect both product quality and brand reputation.

To implement or optimize antimony color measurement in your operation:

- Standardize your measurement method using the procedures outlined in this document
- Evaluate your current instrumentation and workflows for consistency and repeatability
- Establish correlation and validation studies to align with existing standards
- Leverage EasyMatch Essentials L2 and Quality Central for scalable, enterprise-wide quality control

For application support, method development, or instrument selection, contact HunterLab to develop a tailored solution aligned with your materials, processes, and quality requirements.