

FOR USERS NEW TO INSTRUMENTAL COLOUR MEASUREMENT

Colour Measurement Guide

Light, perception and numbers · Geometry and sample handling · Choosing the right instrument

Two samples can look identical in the laboratory and different under shop lighting. People also judge the same colour differently. Instrumental colour measurement replaces opinion with numbers: a spectrophotometer measures how a sample reflects or transmits light at each wavelength and turns it into standard values such as **CIE L*a*b*** and **ΔE**. This guide explains the basics you need to measure colour reliably and to choose suitable equipment.

Light · object · observer

Metamerism

CIE L*a*b* and ΔE

d/8 and 45/0

SCI / SCE

Transmittance and haze

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Topic: **Colour measurement basics**

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Spectroscopy & Color catalogue

Spectroscopy & Color — overview

SC810 portable spectrophotometer

Request quote

STEP 1

Understand light and perception

STEP 2

Express colour as L*a*b* and ΔE

STEP 3

Measure with the right geometry

STEP 4

Choose the instrument



Colour control · plastics, paints, inks, textiles, food and laboratories

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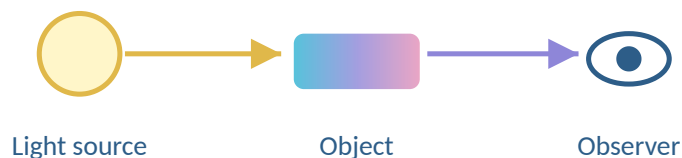
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How colour is created and seen

Colour is not a property of the object alone

1 • LIGHT SOURCE, OBJECT AND OBSERVER



We see colour when **light** falls on an **object**, the object absorbs part of the spectrum and reflects or transmits the rest, and an **observer** (eye and brain, or an instrument) receives it. Change any of the three and the colour impression changes. An instrument fixes all three: a defined light source, a defined measuring geometry and a standard observer (2° or 10°).

Perception and lighting

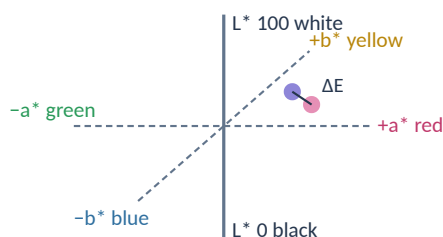
Standard illuminants: D65 (average daylight), A (incandescent lamp), F/CWF and TL84 (fluorescent shop and office lighting), UV (reveals optical brighteners and fluorescence).

Metamerism: two samples match under one light and differ under another, because their spectra differ. It is typical when the sample and standard use different pigments or materials.

Light booth: a viewing cabinet with several standard lights lets you check visually for metamerism. It complements, but does not replace, measurement.

Human factor: colour vision differs between people and changes with fatigue, surroundings and sample size.

2 • COLOUR AS NUMBERS: CIE $L^*A^*B^*$, L^*C^*H AND ΔE



L^* lightness (0 black – 100 white), a^* red (+) / green (–), b^* yellow (+) / blue (–). L^*C^*h expresses the same colour as lightness, chroma (saturation) and hue angle — often easier to interpret.

Colour difference ΔE

ΔE is the distance between standard and sample in colour space. ΔE^*ab is the classic formula; ΔE_{2000} (ΔE_{00}) is corrected to match visual judgement more closely and is preferred for tolerances.

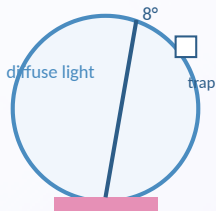
ΔE (general orientation)	Typical perception
below 1	hardly visible
1 – 2	visible to a trained eye in direct comparison
above 2 – 3	clearly visible

These values are a rough orientation only. The acceptable tolerance depends on the material, colour and application and is agreed between customer and supplier, together with formula, illuminant and observer.

How to measure reliably

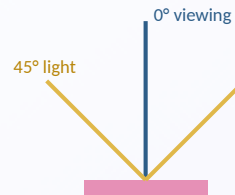
Measuring geometry, sample handling and comparability

3 • MEASURING GEOMETRY



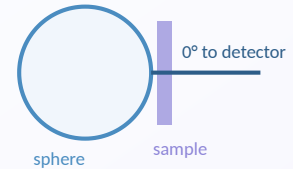
d/8 — sphere, reflectance

Diffuse illumination from an integrating sphere, viewing at 8°. Measures colour largely independent of surface texture. Standard for colour formulation and QC of plastics, paints, textiles and paper.



45/0 — as the eye sees

Light at 45°, viewing at 0°. Gloss is excluded much as in visual assessment, so results follow the visual impression of the surface. Common in printing, coatings and for appearance checks.



d/0 — transmittance

Light passes through the sample. Used for transparent and translucent films, sheets, glass and liquids in cuvettes. The same set-up gives **haze** (ASTM D1003) for transparent plastics.

SCI and SCE — the role of gloss

SCI (specular component included) measures the colour of the material regardless of gloss — best for formulation and comparing materials. **SCE** (specular component excluded) leaves out the gloss reflection and follows the visual appearance — useful when surface finish matters. Instruments measuring both at once show the effect of gloss directly.

Aperture and sample size

The measuring aperture must be fully covered by a flat, uniform area of the sample. Large apertures average texture and small variations; small apertures are for small parts and narrow areas.

Good practice

Calibrate with the white tile and black trap as specified, and keep the tile clean.

Prepare samples consistently: same thickness, flat surface, opaque samples thick enough not to show the background; translucent samples measured over a defined backing or in transmittance.

Measure several times at different positions and use the average.

Control temperature — many plastics and pigments change colour slightly with temperature.

Repeatability (same instrument) is not the same as **inter-instrument agreement** (between instruments). For comparable results keep geometry, aperture, SCI/SCE, illuminant, observer and formula identical, and check with reference standards.

Standards: CIE 15, ASTM E1164, ISO 7724, DIN 5033; haze ASTM D1003.

How to choose the instrument

Start from the sample and the values you report

4 • SAMPLE AND REQUIREMENT → INSTRUMENT TYPE

Sample / requirement	Instrument type	COLO.Science
Opaque plastics, paints, textiles, paper — formulation and QC in the laboratory	Benchtop spectrophotometer d/8 (reflectance)	CS6080 / CS6020
Opaque and translucent plaques, films, liquids — one instrument	Benchtop spectrophotometer d/8 + d/0 (reflectance and transmittance)	CS6080 / CS6020
Finished parts, production line, incoming inspection; liquids and powders with test component	Portable spectrophotometer d/8	SC810
Wet, hot, soft or powder samples that must not be touched	Non-contact benchtop spectrophotometer 45/0	on request
Metallic and effect paints	Multi-angle spectrophotometer	on request
Surface gloss of coatings and plastics	Gloss meter 20° / 60° / 85°	on request
Clarity of transparent films and sheets	Haze meter (ASTM D1003)	on request
Visual assessment and metamerism check	Light booth with standard illuminants	on request

Questions to answer before buying

Samples: opaque, translucent or transparent; solid, film, liquid or powder; size of the measuring area.

Values: colour space, ΔE formula, illuminant/observer, indices (whiteness, yellowness, haze).

Comparability: must results match existing data, a reference instrument or customer measurements?

Use: laboratory, production or field; software, data export and archiving.

ADVICE AND SUPPORT

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Send us your sample type and the values you report — we recommend the instrument and configuration and confirm it with the quotation.

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This guide gives general information for orientation. Tolerances and test methods are defined by the applicable standards and by agreement between customer and supplier.