CIELAB & ΔE — One-Page Cheat Sheet

1) What is CIELAB?
CIELAB (L*a*b*) is a perceptually uniform, device-independent color space used for measurement and tolerance control.

2) L*, a*, b* Axes

L*: Lightness (0 = black, 100 = white)
a*: Green (−) ↔ Red (+)
b*: Blue (−) ↔ Yellow (+)
Neutral gray ≈ a* = 0, b* = 0

3) How Lab Is Measured

Measured using a colorimeter or spectrophotometer under controlled illumination (commonly D65). Reflectance → XYZ → L*a*b*.

4) Color Difference: ΔE

ΔE quantifies visible color difference between two Lab values. Lower ΔE = closer match.

ΔE Method	Use Case
ΔE*ab (1976)	Legacy, simple math
ΔE94	Graphic arts
ΔE00 (CIEDE2000)	Modern industry standard

5) Visual Meaning of ΔE

ΔE Range	Visual Difference
< 1.0	Not perceptible
1 – 2	Barely perceptible (experts)
2 – 3	Noticeable
> 5	Obvious mismatch

6) Typical Engineering Specs

High-end optics & cosmetic parts: ΔE00 ≤ 1.0
Visible equipment panels: ΔE00 ≤ 2.0
Internal / non-cosmetic parts: ΔE00 ≤ 3–5

7) Best Practices

Always specify illuminant (D65), observer angle (2° or 10°), surface finish, measurement geometry, and ΔE method (prefer ΔE00).

Rule of Thumb: Design in RGB, print in CMYK, inspect & control in Lab.