Flicker, stroboscopic effect and *low-end dimming*: what to ask for in an LED fitting specification

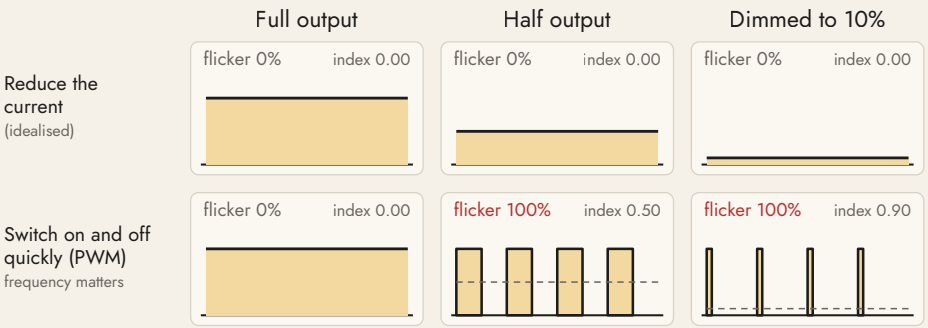
Flicker, the stroboscopic effect and low-end dimming: the terms, what the UK Regulations limit and where they stop, why dimming causes trouble, and wording that asks for the figures at the levels the room will use.

Compliance guidance. UK limits are quoted from SI 2021/1095 (revised text, legislation.gov.uk, read 6 November 2026). California figures are from a California Energy Commission slide. IEEE 1789-2015 (shown by IEEE as Inactive-Reserved), NEMA 77, IEC TR 61547-1 and IEC TR 63158 were named, not read. We give no medical advice. Figures in square brackets are examples. Guidance, not legal or electrical advice.

AT A GLANCE

Term	Plain meaning	Metric	Number we found	Where it comes from
Flicker	Visible unsteadiness of light, seen with a still eye and a still scene	Pst LM (1.0 = an average observer has a 50% chance of seeing it)	UK: 1.0 or less at full load, for LED and OLED mains light sources	SI 2021/1095 Sch 1, Sch 3 Table 5
Stroboscopic effect	Moving objects look jerky or frozen under the light	SVM (1.0 = visibility threshold for an average observer)	UK: 0.4 or less at full load from 1 Sep 2024 (0.9 before)	SI 2021/1095 Sch 1, Sch 3 Table 5
Percent flicker, flicker index	How deep, and what shape, the swing in light is	0 to 100%; 0 to 1. Neither weighs frequency	California 2019: below 30% at 200 Hz or lower. No UK limit	DOE; CEC JA8-2019 slide
Phantom array	A trail of spots when the eye moves past the light	No agreed metric in the 2017 material	No UK limit	DOE; CIE workshop deck
Low-end dimming	The lowest stable level and how smoothly it is reached	Per cent of full light output	California 2019: 10% or lower. DALI levels run to 0.1% (DiiA)	CEC; DiiA
Camera banding	Bands or flashes in video or photographs	Outside these human-vision metrics	None	CIE workshop deck

Read on 6 November 2026. The UK limits are at full load only. California figures are a US precedent, not a UK requirement.



Example waveforms drawn for this sheet, not measurements of any product. Dashed line: the average light.

Two ways to dim an LED at full output, half and 10 per cent: reducing the current (idealised, no flicker) and pulse-width modulation (switching on and off). Example waveforms, not measurements of any product. Original drawing by Make Bespoke Studio.

SPECIFICATION WORDING

FLICKER AND STROBOSCOPIC EFFECT AT EVERY LEVEL

At each of [100, 50, 25 and 10 per cent and the lowest level] of full light output, on the control chain in the dimming schedule, the fitting is to have Pst LM not more than [1.0] and SVM not more than [0.4], measured on the supplied model by [accredited laboratory], and reported with the waveform, the modulation frequency and the percent flicker at each level. These are the specifier's limits: the UK Regulations apply Pst LM 1.0 and SVM 0.4 at full load only [where they apply]. In [space where guests stay for hours] not more than [ ].

LOWEST LEVEL AND SMOOTHNESS

Lowest stable level [1] per cent of full light output on the specified control chain. From full output to the lowest level the light is to dim smoothly, with no visible steps, flash, drop-out, buzz or colour jump, and the fitting is to go fully off, with no glow, when commanded off. The dimming method of each driver [constant current reduction / pulse-width modulation at not less than [ ] Hz / other] to be stated on the shop drawing.

FILMING

Where [space] is to be filmed or photographed, no visible banding or flicker is to appear in video at [ ] frames per second and [shutter setting] at the evening scene and at the lowest level, shown on the mock-up and recorded.

EVIDENCE AND MOCK-UP

The partner is to supply the driver data sheet with flicker data at the stated levels. One fitting on the real control chain is to be stepped through every level and approved in writing by [lighting designer] before production. Any change of driver, dimmer, module or dimming method after approval is to be tested again.

TERMS USED

Flicker

The perception of visual unsteadiness caused by light that fluctuates with time, for a still observer in a still scene (SI 2021/1095 Sch 1; CIE e-ILV 17-22-092).

Stroboscopic effect

A change in motion perception caused by fluctuating light, for a still observer in a moving scene. Its metric is SVM, where 1 is the visibility threshold for an average observer (SI 2021/1095 Sch 1).

Pst LM and SVM

The metrics for flicker (short-term, light flickermeter method; 1 means a 50 per cent chance an average observer sees it) and for the stroboscopic effect, which the UK Regulations limit at full load.

Percent flicker and flicker index

Two measures of the waveform: 100 x (peak - trough) / (peak + trough), and the area above the average over the total area (CIE e-ILV 17-22-094).

STANDARDS AND SOURCES

- SI 2021/1095, Lighting Products Regulations 2021 (Sch 1, Sch 2 Table 1, Sch 3 Table 5 and para 11, Sch 9): revised text, read 6 Nov 2026.
- IEC TR 61547-1:2020; IEC TR 63158:2018: IEC webstore scope read; not read in full.
- CIE e-ILV 17-22-092, 17-22-094; CIE TN 006:2016 (superseded by CIE 249:2022): definitions read.
- IEEE 1789-2015 (Inactive-Reserved); NEMA 77-2017: named, not read; check the current status.
- US DOE and PNNL: LED Dimming (2012); SSL Flicker Fundamentals (2014); Fighting Flicker (2019); PNNL-22945: dated, US-centred.
- California Energy Commission, 2019 Energy Code: Residential Lighting (JA8-2019): JA8-2022 not read.

Full guide: https://makebespoke.com/trade/technical/flicker-and-low-end-dimming. Make Bespoke Studio coordinates manufacture through its partner workshops. Figures are guidance only and your specification governs; some may be superseded, so contact the studio to verify.