Building Performance

APIS GUIDE 14 · BUILDINGS

Lighting that people *can work under.*

Nobody can see a lux level. Everybody can see glare, flicker and a room that feels wrong. Lighting is specified on the one thing occupants never experience and judged on everything nobody specified.

APIS · ELECTRICAL & LIGHTING

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ABOUT THIS GUIDE

The only building service *the occupant sees.*

Lighting is unlike every other system in this series. Ventilation, heating, power and fire protection are judged by whether anyone notices them. Lighting is looked at, directly, by everybody in the building, for the whole working day — and it is the one system bought on the price of the box.

That mismatch produces a familiar outcome. A building replaces its lighting, the electricity bill falls, the project is recorded as a success, and the people working there find the space harsher, flatter or more tiring than before. Energy was saved. The visual environment was degraded. Nobody measured the second thing because nobody specified it.

This guide covers what lighting is actually for, why so many LED replacements disappointed, the qualities that decide whether lighting is good — of which illuminance is only one — daylight, the controls layer that delivers more of the saving than the luminaire does, the statutory emergency lighting obligation attached to the same project, and how to specify and tender so you get what you intended. It ends with a forty-point checklist.

> WHAT THIS GUIDE WILL NOT TELL YOU
>
> **No illuminance levels, no uniformity ratios, no glare limits, no colour rendering minima, no emergency lighting durations, no power density targets.** Those are set by the applicable standards for the specific task and space, and applied by a lighting designer to your building.
>
> A buyer who lifts a number from a general guide has specified a value without the context that makes it correct — and in lighting the context is everything, because the same illuminance can be excellent or unbearable depending on how it is delivered.
>
> What this guide gives is the vocabulary to ask properly, the qualities to require, and the questions that separate a designed scheme from a catalogue of luminaires.

Who this is written for

- Building owners and managers planning a lighting replacement or a refurbishment
- Industrial and warehouse operators, where the task and the space differ most from an office
- Public bodies procuring lighting on their own estate
- Developers and fit-out clients specifying for future occupants
- Anyone who has replaced their lighting, saved energy, and had complaints since

What this guide is not

It is not a lighting design, and it does not replace a lighting designer. It does not cover architectural or decorative lighting design as a discipline, street and public lighting, or the electrical infrastructure supplying the installation — that is Guide 13 in this series, and the two are companion documents from the same division.

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SECTION 01

What lighting *is actually for.*

Four jobs, of which energy efficiency is not one — it is a constraint on how the four are delivered.

A lighting installation exists to do four things. Energy consumption is not among them; it is the cost of doing them. A scheme that saves energy and fails at any of the four has not succeeded at a lower cost — it has failed at a lower cost.

THE FOUR JOBS

Job	What it means	How it fails
Let people see the task	Enough light, distributed appropriately, on the thing being worked on — which is rarely the floor and rarely uniform across a space	Light delivered to the room rather than to the task. A space can meet an average figure and leave the actual work in shadow
Let them see safely	Circulation, hazards, changes of level, machinery, vehicle movement. Different from task lighting and often overlooked in industrial spaces	Contrast that hides a step, glare that blinds at a transition, or dark zones between well-lit areas
Be comfortable to be in	No glare, no flicker, colours that look right, faces that look natural, a room that reads as bright rather than merely measured as bright	**The failure nobody specifies against** and everybody experiences. Section 03
Support what the space is for	A meeting room, a ward, a shop, a warehouse aisle and a workshop each want something different from the same quantity of light	One solution applied to a whole building because it was easier to procure

THE QUESTION THAT REVEALS WHAT YOU ARE BEING SOLD

“What is the task in this space, and where does it happen?”

A designer answers with the working plane, the orientation of the task, where people stand, what they look at, and what surfaces surround it. A supplier answers with a floor area and a luminaire count.

Both may produce a scheme that meets the numbers. Only the first will produce one that people are content to work under, because the numbers are averages across a plane and the experience is specific to a position, a direction and a moment.

Where the standard answer stops working

Office-type spaces are the best-served case and the one most schemes are built around. The spaces where a generic approach reliably disappoints:

- **High-bay industrial and warehousing** — where mounting height, racking and vertical surfaces dominate, and where lighting the aisle is a different problem from lighting the floor
- **Workshops and process areas** — where the task is small, three-dimensional, moving, or reflective, and where shadow and modelling matter more than average level

- **Retail and hospitality —** where lighting is part of how the space sells, and colour rendering and accent are the point rather than a refinement
- **Healthcare —** where clinical tasks, patient comfort and staff working at night all conflict, and Guide 01 covers the adjacent ventilation question
- **Education —** where the task changes hourly and where glare on a screen and on a board are different problems
- **Spaces with significant daylight —** where the electric scheme has to work with something that changes all day. Section 04

> LIGHTING IS BOUGHT AT THE WRONG MOMENT
>
> It is typically procured late, as an electrical package, after the ceiling, the surfaces and the layout have been fixed — and each of those has already constrained what the lighting can achieve.
>
> A dark ceiling, a matt dark floor, an open-plan layout that changed after the design, or a partition added after handover will each degrade a scheme that was correct when drawn. **Section 03 makes the point that surfaces are part of the lighting design**, and by the time lighting is usually specified, somebody else has already chosen them.

SECTION 02

Why the LED replacement *disappointed.*

The energy saving was real. The visual result frequently was not — and the reason is the same in almost every case.

A great many buildings replaced their lighting over the past decade and got roughly what they were promised on consumption. A substantial number also got a space that people liked less. Complaints about glare, harshness, flatness and headaches followed installations that were, on paper, successful.

This is worth understanding before commissioning another lighting project, because the mechanism is repeatable and it is still being repeated.

> A LAMP IS NOT A LUMINAIRE
>
> A luminaire is designed as a whole: the light source, the reflector or optic, the diffuser and the housing together determine how light leaves the fitting and where it goes. That distribution is what the designer used.
>
> **Replacing the source inside a luminaire designed for a different source changes the distribution**, and usually not favourably. An optic shaped for a long diffuse tube behaves differently with a strip of small intense points behind it. The result is frequently a brighter, harder source that the fitting was never designed to control — visible as glare, as harsh shadows, and as a ceiling that reads as a row of bright objects rather than as light.
>
> The saving is real. The scheme, in the sense a designer would use the word, no longer exists.

The four mechanisms, in the order they cause complaints

1. **Distribution changed but the layout did not.** Luminaire positions were set for the old distribution. The new source lights a different pattern from the same positions, producing uneven results and dark zones between bright ones.
2. **Higher luminance from a smaller area.** The same light output from a much smaller emitting surface is a much brighter thing to look at. That is what glare is, and it is why some replacements feel harsh at the same measured level.
3. **Colour chosen by default.** A cooler colour temperature is frequently supplied as standard and reads as clinical in spaces that were comfortable under warmer light. Colour rendering may also have dropped, which makes materials, products and faces look wrong in ways people report as “the room feels off” rather than as a lighting complaint.
4. **Flicker.** Driven by the driver rather than the source, invisible to most people as flicker, and reported as eye strain, headache or fatigue. Section 03 — **this is the most under-diagnosed complaint in lighting**, because the symptom does not name the cause.

IF YOU HAVE COMPLAINTS AFTER A LIGHTING REPLACEMENT

They are usually real and usually diagnosable. Before dismissing them:

- **Ask what the complaint actually is —** too bright, hard to look at, tiring, colours wrong, uneven, or a screen that is hard to read. Each points somewhere different
- **Check for flicker**, particularly where complaints are headaches or eye strain rather than visual dissatisfaction. It is measurable and it is frequently the answer
- **Look at the ceiling from a seated position**, not standing in the doorway. Glare is a function of viewing angle, and the person who assesses a space is rarely sitting where the complaints come from
- **Check what was replaced with what —** whether it was a whole-luminaire replacement or a source swap, and whether the layout was reconsidered

Some of these are fixable cheaply: changing colour temperature, adding diffusion, relocating or removing luminaires, adjusting controls. **Others require the redesign that was skipped.** Establishing which before spending is worth an assessment.

The maintenance change nobody planned for

Older lighting failed predictably: lamps had a rated life, they were replaced in groups, and the installation was maintained on a cycle. The current situation is different in ways that arrive around year seven or eight:

- **Drivers fail individually**, not on a cycle, producing a slow scatter of dead fittings rather than a planned replacement
- **Light output declines gradually** rather than ending, so a space dims over years without anyone noticing until it is measured or complained about
- **Products are discontinued faster than they fail.** A luminaire installed today may be unavailable in five years, and a partial replacement then means visibly mismatched fittings — different colour, different appearance, different output
- **Integrated luminaires may not be repairable** at all, making the failure of a component the failure of the fitting

Ask at purchase: what is the spares position, is the driver replaceable, is the module replaceable, and what is the manufacturer's stated availability period? Section 07 makes this a specification item. It is the question that most distinguishes a considered purchase from a cheap one, and it costs nothing to ask.

SECTION 03

The qualities that decide *whether it is good.*

Illuminance is one of them. It is also, almost always, the only one in the specification.

Ask what lighting a space needs and the answer will be a number of lux. That number is necessary and it is a small part of the answer. The qualities below are what an occupant actually experiences, and a scheme can meet its illuminance target while failing every one of them.

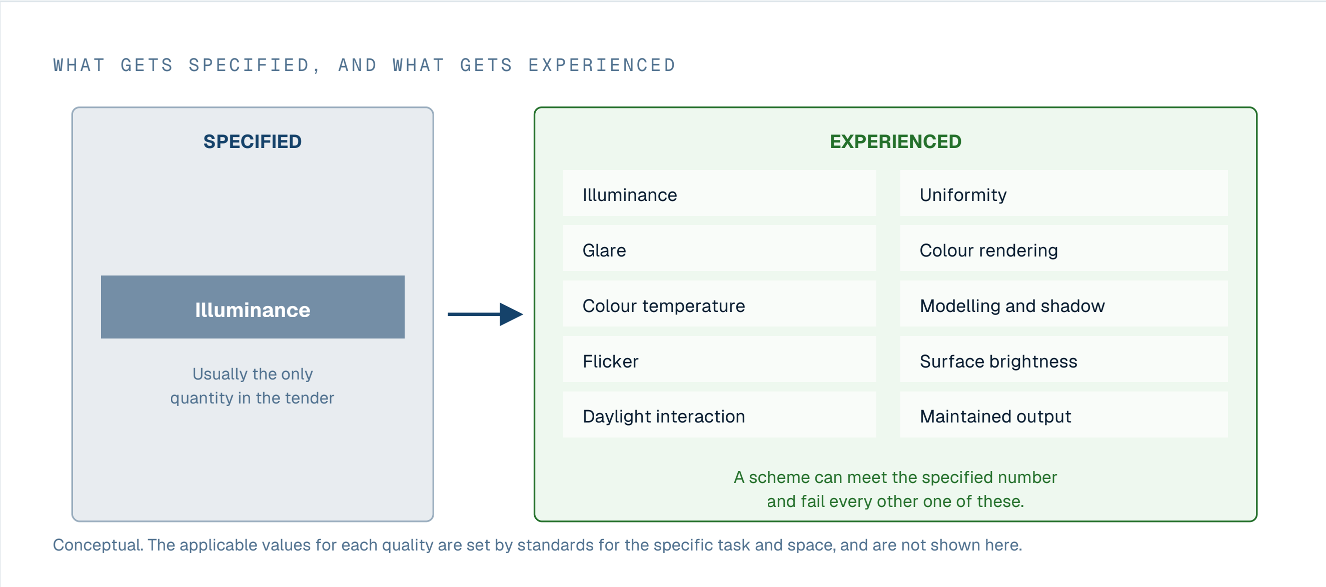

Figure 3.1 — The gap between what is specified and what is experienced. Conceptual only; the applicable values for each quality are set by the relevant standards for the specific task and space.

THE QUALITIES, AND WHAT EACH ONE DOES TO A SPACE

Quality	What it governs, and what goes wrong
Illuminance	How much light reaches the task. Specified on a working plane, which is an abstraction — the task may be vertical, tilted or inside something. **Ask what plane the figure applies to**
Uniformity	How evenly it is distributed. A space averaging its target with bright pools and dark gaps is worse than a lower, even level, because the eye adapts to the bright areas
Glare	Discomfort or disability from luminaires that are too bright to look at, or from reflections in screens and polished surfaces. **Governed by luminaire luminance and viewing angle**, which is why a fitting can be acceptable standing and unbearable seated
Colour rendering	Whether colours look as they should. Matters enormously in retail, healthcare, food, print, paint and any inspection task — and matters to everyone, because faces are a colour
Colour temperature	Whether light appears warm or cool. Largely preference and convention, but wrong for a space it reads as clinical or as gloomy, and it is the quality most often left at the supplier's default
Modelling and directionality	Whether three-dimensional objects and faces look natural. Entirely flat light is as unpleasant as harsh shadow, and it is a real defect in workshops and in any space where people meet
Flicker	Rapid variation in output, mostly invisible, reported as headache, eye strain and fatigue. Determined by the driver. **The most under-diagnosed complaint in lighting**, and cheap drivers are the usual cause
Surface brightness	How bright the room reads, which depends on walls and ceilings as much as on luminaires. A dark ceiling absorbs light a bright one would return
Daylight interaction	How the electric scheme behaves alongside a source that changes all day. Section 04
Maintained output	What the scheme delivers at the end of its life, not on day one. Design allows for depreciation and dirt; if the allowance is wrong the space is under-lit for most of its life

SPECIFY AGAINST FLICKER EXPLICITLY

Flicker is the one quality on this list that is invisible to the buyer, invisible at handover, and cheap for a supplier to compromise on — because it lives in the driver, which is the component a price-driven specification pressures hardest.

It is measurable, there are established metrics for it, and reputable manufacturers publish performance data. **Require the data for the products offered, and require flicker performance to be part of the technical submission rather than assumed.**

This guide states no limit — the applicable metric and threshold should come from your designer against current guidance. What it does state is that if you do not ask, you will not be told, and the complaints will arrive as headaches that nobody connects to the lighting.

Surfaces are part of the lighting design

A significant proportion of the light in a room reaches the eye after bouncing off a wall, a ceiling or a floor. Their reflectance is a design input, and it is chosen by somebody who is usually not thinking about lighting.

The practical consequence: **repainting a ceiling can be a cheaper route to a brighter room than adding luminaires**, and specifying a dark finish after the lighting is designed will quietly undo part of it. Where a scheme is being designed alongside a refurbishment, the surface finishes and the lighting should be discussed in the same conversation — and they almost never are.

SECTION 04

Daylight, and the cheapest light *in the building.*

Free, preferred by occupants, already present in most buildings — and routinely ignored by the electric scheme installed alongside it.

Most commercial and industrial buildings receive substantial daylight for much of the working day. In a great many of them the electric lighting runs at full output regardless, because nothing in the installation is aware that daylight exists.

That is simultaneously the largest available energy saving in most lighting schemes and a comfort question, because occupants consistently prefer daylit spaces and respond to them differently from electrically lit ones.

DAYLIGHT IS A LIGHTING DESIGN INPUT, NOT A BONUS

A scheme designed as though the building were windowless, then installed in a building with windows, will over-light the perimeter for most of the year and under-serve the depth of the space — while consuming full power throughout.

Designed with daylight, the same building gets luminaires arranged and controlled by their relationship to the windows: switched or dimmed in rows parallel to the glazing, so the perimeter responds and the interior does not. **This costs almost nothing at design stage and is impossible to retrofit sensibly if the circuits were laid out the other way.**

The circuit layout is the decision. Section 05 covers the controls that use it — but controls cannot dim a perimeter row that was wired in series with the middle of the room.

What to establish about daylight before designing

- **Where it enters and how deep it reaches —** window area, orientation, head height and room depth. Rooflights in industrial buildings behave very differently from side windows and are frequently the strongest daylight source available
- **What obstructs it —** neighbouring buildings, overhangs, and internal partitions that were added after the building was designed
- **Whether glare and solar gain are being managed**, and how. Blinds that are closed permanently because of glare have converted a daylit building into an artificially lit one, and that is a very common condition
- **How the space is used through the day**, since the value of daylight depends on somebody being there when it is available
- **The state of the glazing and rooflights —** dirty or degraded rooflights in older industrial buildings can transmit a fraction of what they should, and cleaning or replacing them is frequently cheaper than the lighting they make necessary

THE BLIND THAT IS NEVER OPENED

Where occupants have closed the blinds permanently, the building has a glare problem that is being solved by eliminating daylight — and the electric lighting is then running to replace light that is available outside the window.

The fix is a shading question rather than a lighting one, and it belongs in the same project: shading that controls glare while admitting light, rather than shading that admits nothing. **Where a lighting scheme is designed on the assumption of available daylight and the blinds stay shut, the saving does not happen** — and this is the single most common reason a daylight-linked scheme underperforms its prediction.

Industrial buildings specifically

Warehouses and production buildings often have rooflights covering a meaningful share of the roof, and therefore have more daylight potential than any office. They also frequently run full electric lighting through daylight hours, because the installation is switched from a single point and nobody is going to walk to it.

This combination — high daylight availability, high mounting height, long operating hours, and no control — is where the largest and most straightforward savings in the whole subject sit. **It is also where the retrofit is easiest**, because high-bay luminaires are individually addressable in a way a plastered ceiling is not, and because a control device can be integral to the fitting.

SECTION 05

Controls — where the saving *actually is.*

A more efficient luminaire saves while it is on. A control saves by turning it off — and light that is not needed is the cheapest light there is.

Lighting projects are usually justified on the efficiency of the new luminaire. That is the smaller half of what is available. The other half is not lighting empty rooms, not lighting daylit perimeters, and not lighting at full output a space that needs less.

Controls are also the element most often removed when a budget is squeezed, because they are invisible on a schedule and because the luminaire count is what makes a scheme look complete.

THE CONTROL LAYERS, AND WHAT EACH IS FOR

Layer	What it does	Where it earns its place
Local switching	Somebody can turn lights off in the area they are in	Everywhere. The most basic control and frequently absent — a whole floor on one switch is a floor that stays lit
Presence and absence detection	Lights respond to occupancy. **Absence detection — manual on, automatic off — usually saves more than presence detection**, because it does not light a space somebody merely walked past	Intermittently occupied spaces: meeting rooms, stores, plant rooms, toilets, corridors, warehouse aisles
Daylight linking	Output reduces as daylight increases, ideally by dimming rather than switching	Anywhere with meaningful daylight. Depends on the circuit layout of Section 04
Time scheduling	Lighting follows building hours rather than being left on	Buildings with defined occupancy. Simple, cheap and frequently the largest single saving in a building that currently has none
Task tuning and scene setting	Levels set for the actual task rather than a maximum, adjustable by area	Where uses vary within a space, and where an initial over-provision can simply be dimmed to what is needed
Monitoring	Reporting energy, hours, faults and failed luminaires	Larger estates, where finding a failed fitting is otherwise a walking exercise. Also how you demonstrate the saving — Section 08

THE CONTROLS FAILURE IS THE SAME AS EVERY OTHER CONTROLS FAILURE

Guide 09 in this series makes the argument at building scale and it applies here without modification: **a control system nobody commissioned, nobody owns and nobody can adjust reverts to default and delivers nothing.**

In lighting it presents specifically as: sensors with time delays left at factory settings so long they never switch off; daylight sensors positioned where they see a luminaire rather than the window; scenes set once by the installer and never revisited; and occupants who defeat the system because it does something they did not expect and nobody explained.

Require commissioning of the controls as a distinct deliverable, with the settings recorded and the reason for each given — and require somebody in the building to be shown how to change them.

Openness, and the same lock-in question

Lighting controls carry the identical question raised in Guides 08, 09 and 11 about charging, building controls and networks. **DALI — standardised within the IEC 62386 series — is the established open protocol for lighting control**, and a system built on it can in principle be extended, reconfigured and maintained by more than one company.

Ask the same four questions Guide 09 §05 sets out: which protocol and version; which functions are implemented; can a third party configure this system with standard tools; and name a project where somebody other than the installer took it over. A proprietary control system on a fifteen-year installation is a fifteen-year supplier relationship you did not negotiate.

CONTROLS THAT ANNOY PEOPLE GET DISABLED

Every control decision has an occupant consequence, and occupants win. Lights that switch off while somebody is sitting still. Corridors that go dark ahead of a person walking. A meeting room that dims during a presentation. Each produces the same response — the sensor gets covered, the override gets taped, or maintenance is asked to disable it.

Design the control strategy around how people actually behave, allow manual override where it matters, set delays that reflect real occupancy rather than a default, and explain the system to the people who live with it. A control that is disabled saves nothing and cost something.

SECTION 06

Emergency lighting — *the statutory half.*

Attached to the same project, governed by different rules, carrying a duty that does not expire — and routinely treated as an afterthought in a lighting refit.

Emergency lighting is not part of the visual design discussion. It is a statutory provision whose purpose is that people can leave the building safely when the normal supply fails, and it is subject to its own standards, its own testing regime and its own record-keeping obligation.

It is also, frequently, physically integrated with the general lighting — which means a lighting replacement is an emergency lighting project whether or not anyone treated it as one.

> A LIGHTING REPLACEMENT CHANGES THE EMERGENCY PROVISION
>
> If the luminaires being replaced included emergency function, or if the layout changes, or if circuits are reconfigured, **the emergency lighting design has been altered — and it must be reassessed, re-certified and re-recorded, not simply reproduced.**
>
> The common failure is a like-for-like replacement in which emergency fittings are swapped for equivalents without anyone confirming that the coverage still satisfies the requirement, or that the escape route lighting still corresponds to the current escape routes — which may have changed since the original design.
>
> **Treat the emergency lighting as a designed element of the project with its own certification**, and reconcile it against the building's fire strategy. Guide 12 in this series covers that reconciliation from the fire side, and the two documents should agree.

What the provision has to address

The applicable requirements come from the standards and from national regulation. EN 1838 covers lighting applications for emergency lighting, and EN 50172 covers emergency escape lighting systems. **This guide states no level and no duration.** The elements to establish are:

- **Escape route lighting** — along the routes people will actually use, which must match the current escape strategy rather than an old one
- **Open area lighting** — so that occupants in a space can reach an escape route
- **High risk task area lighting** — where a process must be shut down safely before leaving. Frequently missed in industrial buildings
- **Specific locations requiring illumination** — including changes of level, stairs, direction changes, exits, call points, firefighting equipment and first aid points
- **Signage**, its type, its illumination, and whether it remains visible and correct after any layout change
- **Duration and level**, from the applicable requirements for the building type
- **External illumination** at exits, to a place of safety rather than just to a door

Self-contained or central, and the maintenance that follows

Arrangement	Consequence for the life of the installation
Self-contained — battery in each luminaire	Simpler to install and to extend. **A population of batteries with individual lives**, each needing testing and eventual replacement, distributed across the building
Central battery	One battery system to maintain rather than hundreds, and easier to monitor. Requires dedicated circuits and a plant space, and a single point whose failure affects everything
Automatic test systems	Test themselves and report, removing the largest practical obstacle to compliance. **Worth serious consideration on any installation of scale** — the alternative is somebody walking the building with a key and a logbook

THE REGIME THAT LAPSES QUIETLY

Emergency lighting carries a continuing testing obligation with prescribed activities and intervals, and a requirement to record them. The record is the evidence, and a system tested without records is indistinguishable afterwards from one never tested.

It lapses for ordinary reasons: the person who did it leaves, the logbook is misplaced, testing requires putting an area into darkness and there is never a convenient time, and a full-duration discharge test leaves the batteries flat for the recharge period afterwards — which people avoid.

Establish at handover who holds this duty by name, what the schedule is, and where the record lives. Where the installation is large or the building is difficult to test in, automatic testing removes most of the reasons it stops happening.

SECTION 07

Specifying *and tendering it.*

A lighting tender that lists luminaires buys luminaires. A lighting tender that states qualities buys lighting.

The commonest lighting tender is a schedule of fittings and quantities, sent to several suppliers, awarded on price. Every bidder prices the same list, the cheapest wins, and the scheme delivered is whatever that list produces — which nobody has evaluated, because the list was the specification.

The alternative is not more expensive. It is a specification that states what the lighting must achieve, leaving the supplier to demonstrate that their products achieve it.

WHAT THE SPECIFICATION MUST STATE

Item	What to require
The task and the space, per area	What is done there, where, and on what plane. Section 01 — the input a designer needs and a schedule does not contain
The applicable standard and the values from it	Determined by your designer for each space type against EN 12464-1 or the outdoor part, not selected by the bidder
Uniformity, glare and colour rendering	Stated as requirements, per area. **These are the qualities a price-driven offer will trade away**, and only a stated requirement prevents it
Colour temperature	Chosen deliberately per space rather than left at the supplier's standard
Flicker performance	Required as part of the technical submission, with published data for the products offered. Section 03
Photometric data	In a standard format, for the products actually offered — so the scheme can be verified by calculation rather than by assertion. EN 13032 addresses the measurement and presentation of photometric data
Maintenance factor and its basis	What depreciation and dirt allowance was assumed, and the cleaning and replacement regime it depends on. **A generous maintenance factor is how a scheme is made to appear adequate on paper**
Surface reflectances assumed	Stated in the calculation, and checked against what the finishes will actually be. Section 03
Control strategy per area	Which layers, with the circuit layout that supports daylight linking. Sections 04 and 05
Control protocol and openness	Named, with version and required functions, plus the third-party configuration question. Section 05
Emergency lighting	Designed, not reproduced, with its own certification. Section 06
Spares, availability and repairability	Driver and module replaceable or not; manufacturer's stated availability period. Section 02 — **the question that most distinguishes a considered purchase**
Product standards and certification	For the specific models offered, checked on delivery against what was certified
Commissioning and verification	Including measurement after installation, and commissioning of the controls as a distinct activity

REQUIRE THE CALCULATION, AND REQUIRE IT FOR THE PRODUCTS OFFERED

A lighting scheme can be calculated before it is installed, and the calculation is the only way to know whether an offer meets the requirements before the fittings are on the ceiling.

Require a full calculation from every bidder, using the photometric data of the products they are actually offering, showing illuminance, uniformity and glare per area against the stated requirements, with the assumed surface reflectances and maintenance factor declared.

Two things then become visible that a schedule of fittings hides: whether the offer meets the requirement at all, and **what assumptions it needed in order to appear to.** A calculation resting on optimistic reflectances and a generous maintenance factor is an offer that will disappoint on site, and it can only be seen by reading the assumptions.

Evaluating what comes back

- **Compare the calculations, not the fitting counts.** Fewer fittings meeting the requirement is a better scheme; fewer fittings not meeting it is a cheaper bid
- **Read the assumed reflectances and maintenance factor** in each offer and compare them with each other. Differences here explain most price differences
- **Check glare was calculated**, not just illuminance. It is the quality most often absent from a submission
- **Check the flicker data** is for the driver actually supplied
- **Check the controls scope** — whether commissioning is included, and by whom
- **Check emergency lighting** is designed and certified rather than counted
- **Price the whole life**, per Guide 07 — including driver replacement, cleaning and the eventual obsolescence of the product range

ASK FOR A SAMPLE, AND LOOK AT IT IN THE SPACE

Lighting is the one system in this series that can be evaluated before purchase by looking at it. A sample fitting installed in the actual space, seen from where people will sit, at the time of day they will be there, answers questions no data sheet can.

It reveals glare from the real viewing angles, how the colour reads against the actual surfaces, whether the distribution suits the room, and how it looks alongside the daylight. **It costs a supplier very little and it is the single most informative step available to a non-technical buyer.** Ask for it on any project of scale, and ask for the same sample from each shortlisted bidder.

SECTION 08

What it costs to own, *and proving it worked.*

The purchase price is the least interesting number, and the saving is not verified by the fact that the bill went down.

The cost structure

Luminaires and controls	The visible cost, and the one tenders compete on
Installation and access	Frequently the larger figure in an existing building — high level access, working out of hours, and returning a ceiling to its previous condition
Design and calculation	Small, and the item that determines whether everything else was worth spending
Controls commissioning	A distinct activity. Section 05 — and the one most often assumed to be included
Emergency lighting design and certification	Section 06. A separate obligation with a separate cost
Recurring — energy	The saving, and the reason the project was approved
Recurring — cleaning	Directly affects output. **The maintenance factor assumed in the design depends on a cleaning regime actually happening**, and it usually does not
Recurring — driver and module replacement	Individual failures scattered through the installation from around year seven. Section 02
Recurring — emergency lighting testing	A continuing statutory obligation with a labour cost, unless automated
Replacement within life	Product ranges are discontinued faster than fittings fail, so partial replacement means visible mismatch. Consider a spares holding at purchase

BUY A SPARES HOLDING AT THE SAME TIME AS THE INSTALLATION

Where a fitting is discontinued, the replacement will differ in appearance, colour and output — visibly, in a ceiling grid where the difference is next to the original.

A modest holding of the same fittings and drivers, purchased with the installation and stored, covers the failures of the first several years with matching product. It costs a small percentage of the project and it avoids the outcome where a building has three generations of fitting in one room. **Ask the supplier what they recommend holding, and treat a low answer with scepticism.**

Proving the saving

Lighting savings are usually claimed by calculation — old wattage against new wattage, multiplied by hours. That estimate is not verification, and it ignores the controls, which is where a large part of the saving was supposed to come from.

1. **Establish the baseline before the work.** Sub-metered lighting consumption where it exists; where it does not, this is the moment to install it. Guide 05 sets out how a baseline is built properly, and Guide 09 §03 covers the metering
2. **Record the operating hours as they actually are**, not as the building's stated hours. Lighting left on overnight is a real and common condition, and it is where the controls saving comes from
3. **Verify after installation** — measured consumption over a comparable period, against the baseline
4. **Verify the lighting itself, not just the energy** — measure illuminance and uniformity in a sample of spaces against the design, on handover. This is the only opportunity to establish that what was delivered matches what was calculated
5. **Ask the occupants.** A short survey before and after costs nothing and captures the qualities in Section 03 that no meter records. It is also the evidence that matters if complaints arrive later

WHERE LIGHTING SAVINGS QUIETLY DISAPPEAR

- **Controls disabled** because they annoyed somebody. Section 05 — the commonest cause by a distance
- **Delays extended** during commissioning or afterwards, until absence detection effectively never operates
- **Daylight sensors defeated** — covered, or set so that they never respond
- **Schedules overridden** for an event and left overridden
- **Levels raised** in response to a complaint that was actually about glare or colour, which more light does not fix and does make more expensive
- **Cleaning not done**, so output declines and the response is to add fittings

Every one of these is visible in metered lighting consumption within a month or two of it happening — which is the argument for sub-metering the lighting circuits, and for somebody looking at the number. Guide 09 §06 is the same argument in general form.

On payback claims. This guide states no figure. A lighting payback depends on what is being replaced, how many hours it runs, the tariff, how much of the saving comes from controls, and whether those controls remain enabled. A figure quoted before somebody has established the operating hours and the existing consumption is an estimate built on the two variables that matter most — and neither of them is a property of the luminaire being sold.

SECTION 09

The forty-point *checklist.*

Attach it to the tender. Every item is something to establish, require or verify — none is a lighting value, because those come from your designer.

A · BEFORE ANYTHING IS SPECIFIED

- [ ] The task in each space identified — what is done, where, and on what plane
- [ ] Space types listed and the applicable standard values determined by a designer
- [ ] Existing installation surveyed — what is installed, its condition, and what has already been replaced
- [ ] Existing complaints collected and characterised before design
- [ ] Existing lighting consumption established, sub-metered where possible
- [ ] Actual operating hours established, not the building's stated hours
- [ ] Daylight availability assessed — orientation, depth, rooflights, obstructions
- [ ] Whether blinds are permanently closed, and why, established
- [ ] Surface finishes established, and reconciled with the lighting design
- [ ] Emergency lighting treated as a designed element of the project from the start

B · QUALITIES REQUIRED, NOT JUST QUANTITIES

- [ ] Illuminance stated per area, with the plane it applies to
- [ ] Uniformity stated as a requirement
- [ ] Glare stated as a requirement and required to be calculated
- [ ] Colour rendering stated per area, appropriate to the task
- [ ] Colour temperature chosen deliberately per space
- [ ] Modelling and directionality considered where faces or 3D tasks matter
- [ ] **Flicker performance required with published data for the products offered**
- [ ] Maintenance factor and its basis required to be declared
- [ ] Assumed surface reflectances required to be declared and checked against reality
- [ ] Photometric data required in standard format for the products offered

C · DAYLIGHT AND CONTROLS

- [ ] Circuit layout arranged in relation to windows, so perimeter rows can respond separately
- [ ] Control strategy specified per area, layer by layer
- [ ] Absence detection preferred over presence detection where appropriate
- [ ] Daylight linking specified with dimming rather than switching where practical
- [ ] Time scheduling specified where occupancy is defined
- [ ] Manual override provided where occupants will otherwise defeat the system
- [ ] Sensor positions and time delays specified, not left at factory defaults
- [ ] Control protocol named with version and required functions
- [ ] Third-party configuration confirmed possible, with a reference project
- [ ] Controls commissioning required as a distinct deliverable with settings recorded and explained

D · EMERGENCY, PROCUREMENT AND PROOF

- [ ] Emergency lighting designed against current escape routes, not reproduced
- [ ] Emergency provision reconciled with the building's fire strategy
- [ ] Self-contained, central or automatic-test arrangement chosen deliberately
- [ ] Emergency testing duty assigned by name, with schedule and record location established
- [ ] Full calculation required from every bidder using the offered products' photometric data
- [ ] Sample fitting requested and viewed in the actual space from the occupant's position
- [ ] Spares, repairability and stated availability period required and compared
- [ ] Spares holding purchased with the installation
- [ ] Measured verification of illuminance and uniformity required at handover
- [ ] Energy baseline established beforehand, and occupant feedback collected before and after

Lighting project sign-off

Complete and retain with the project file.

LIGHTING PROJECT SIGN-OFF

Item	Name and role	Date and signature
Building and areas in scope		
Design values determined by		
Baseline consumption and operating hours from		
Emergency lighting designed by		
Emergency testing duty held by		
Calculations reviewed by		
Checklist points 1–40 confirmed		
Released for tender by		

IF YOU CAN ONLY DO THREE THINGS

One. Specify the qualities, not just the illuminance — uniformity, glare, colour rendering and flicker. They are what people experience, and only a stated requirement protects them.

Two. Require a full calculation from every bidder using their own products' data, and read the assumed reflectances and maintenance factor. That is where an offer's optimism lives.

Three. Put the controls in and commission them properly. They deliver more of the saving than the luminaire does, and they are the first thing cut and the first thing disabled.

REFERENCE

Standards referred to *in this guide.*

Listed by number and subject. Confirm the current edition and the national adoption before citing any of them in a contract document.

STANDARDS REGISTER

Reference	Subject
EN 12464-1	Light and lighting — lighting of work places, part 1: indoor work places. The principal reference for task lighting requirements
EN 12464-2	Light and lighting — lighting of work places, part 2: outdoor work places
EN 1838	Lighting applications — emergency lighting
EN 50172	Emergency escape lighting systems
EN 13032 series	Light and lighting — measurement and presentation of photometric data of lamps and luminaires. The basis for requiring comparable photometric data in a tender
EN 60598 series	Luminaires — general requirements and requirements for particular types
IEC 62386 series	Digital addressable lighting interface — the standardisation of DALI, referenced in Section 05 on control openness
IEC 61347 series	Lamp controlgear — the drivers, which govern flicker performance
IEC 62471	Photobiological safety of lamps and lamp systems
EN 15193-1	Energy performance of buildings — energy requirements for lighting, including the method for assessing lighting energy use
EN 16247 series · ISO 50001	Energy audits and energy management systems — the framework within which a lighting saving is established and verified. Guide 05
IEC 60364 / HD 60364 series	Low-voltage electrical installations — the installation supplying all of the above. Guide 13

HOW TO USE THIS REGISTER — AND WHAT GOVERNS ABOVE IT

Standards are revised, withdrawn and superseded. Verify the current edition and the national adoption with the standards body applicable to your project, and confirm that the clause you intend to rely on still says what you think it says. Nothing in this guide should be relied upon as a statement of the content of any standard.

Three things govern above all of the above: the national regulations applicable where the building stands, including workplace and fire safety legislation; the building's fire strategy, for anything touching emergency lighting; and the design of a competent lighting designer for the specific spaces. **Where this guide is silent on a numeric value, that silence is deliberate**, and those are the sources that supply it.

On flicker specifically: established metrics exist and guidance continues to develop. **Obtain the current metric and threshold from your designer** rather than from this document, which states neither.

About APIS

APIS is an integrated engineering group founded in Kosovo, operating across the Western Balkans and into the European Union. The Group delivers mechanical, electrical, energy and infrastructure works through twenty-one delivery divisions across two strategic business units — Building Systems & Technologies, and Energy, Industry & Infrastructure — supported by four engineering excellence centres. APIS operates management systems certified to ISO 9001, ISO 14001, ISO 45001 and ISO 50001.

The **Electrical & Lighting Division** carries out lighting design and calculation, survey and assessment of existing installations, controls design and commissioning, emergency lighting design and certification, and the installation and verification that follows. This guide is the companion to Guide 13, which covers the electrical capacity and distribution supplying it — the two halves of the same division and, frequently, of the same project.

Prepared by the APIS Electrical & Lighting Division · **Document** APS-GD-14 issue v1.0 of 20 August 2026 · **Contact** apisgroup.net/contact

Saved the energy, *and now people are complaining?*

It is the commonest outcome of a lighting replacement, and it is diagnosable. Our engineers will establish what the complaint actually is — glare, flicker, colour, uniformity or level — measure it, and tell you which fixes are cheap and which require the redesign that was skipped. Frequently more of it is cheap than anyone expects.

SPEAK TO THE ELECTRICAL & LIGHTING DIVISION

Lighting design and calculation · survey and diagnosis of existing installations · glare, flicker and quality assessment · daylight and controls strategy · controls commissioning · emergency lighting design, certification and testing regimes · installation and measured verification

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Planning the electrical supply as well as the lighting? See Guide 13 in this series.
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