Episode Book

EPISODE #5723

Task Lighting Spec Sheets: Wattage, CRI, Kelvin & Dimming

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SYNOPSIS

Task lighting spec sheets are marketing documents with three or four real numbers buried in them. This episode walks through the four parameters that matter — wattage, CRI/Ra, Kelvin, and dimming range — and shows what each one measures, what it strategically omits, and what to target for a mixed workstation versus a dedicated PCB bench. Along the way: why Ra95 and CRI95 are the same number, why R9 is the spec that decides whether you can read a resistor, and how the 2025 Hartstein melatonin study reframes the Kelvin debate at equal intensity.

TRANSCRIPT



Corn

Quick show of hands, who here has ever bought a lamp based on the wattage on the box?



Herman

Not me. I've bought lamps based on the number of exclamation marks on the box.



Corn

Which is the same number, really. Anyway. Daniel's been going down the task lighting rabbit hole again, and this time he wants to stay on the spec sheet. He works late. He shares the home office with Ezra now, split by a curtain, so he wants something directional and controllable. He tried the monitor light bars, found them wobbly. He's drifted past Ikea into the world of dental clinics and nail salons, which is a sentence I enjoy. And he's trying to make sense of four parameters. Wattage, where he's targeting fifteen to twenty watts for a three monitor desk. CRI, ninety or above, with the question of whether Xiaomi's Ra95 is the same thing. Kelvin. And then the one he can't name, the degree to which you can dial intensity down from full to off, because the circadian research now points harder at intensity than at blue light.



Herman

That's a good list. Those four are exactly where the burying happens.



Corn

So we take each one. What's on the sheet, what's missing from the sheet, and what you'd actually target for a PCB bench versus a mixed desk. Fixtures are next episode, but geometry stays in the room, because it changes what every one of these numbers means.



Herman

Right. Start with the framing, because it matters. A task lighting spec sheet is a marketing document with three or four real numbers buried in it. Daniel's four specs are precisely the ones where the real numbers get buried.



Corn

Buried how?



Herman

Buried in the sense that the sheet will happily tell you a number that sounds like the number you want, while omitting the number that actually predicts how the thing behaves. There are two reference profiles we should keep visible, because the right target for every one of these specs differs between them. Profile one, a mixed workstation, occasional close inspection, a desk that does writing and screens and the occasional look at a board. Profile two, predominantly PCB and electronics work, close inspection as the main job.



Corn

And for each spec we do the same three moves. What you'll see, what they strategically don't list, what to target for each profile.



Herman

One structural caveat up front, and then I'll stop hedging. Lux is distance dependent. Every number we're about to discuss is conditional on where the emitter sits relative to the work. We're not doing fixtures today, but a spec sheet lumen figure on its own is close to meaningless without that.



Corn

Noted, parked, and it comes back at the end. Start with the number everyone reaches for first and which tells you the least. Wattage.



Herman

Wattage measures power consumed. Not light emitted. That's it. That's the whole problem in one sentence. It was a decent proxy for brightness in the incandescent era, because incandescent efficiency was pinned at roughly fifteen lumens per watt. A sixty watt bulb was brighter than a forty watt bulb, every time, because the efficiency was fixed. So the number worked.



Corn

And it stopped working the moment efficiency became a variable.



Herman

LED efficiency across the market runs from roughly eighty lumens per watt to over two hundred. So two fifteen watt lamps can differ by a factor of two in actual output. Same number on the box. One is a dim bulb and one is a serious work light.



Corn

So Daniel's fifteen to twenty watt target.



Herman

Fine as a starting filter. If the fixture is efficient and sits close to the work, fifteen to twenty watts gets you somewhere real. But it's the wrong lever. The lever is lux at the work surface, and lux is lumens per square metre. A thousand lumen lamp at thirty centimetres delivers far more lux at the task than the same lamp at a metre. Beam angle does the same thing, a narrow beam concentrates, a wide flood spreads.



Corn

So the target should be stated in lux and then worked backwards.



Herman

Three hundred to five hundred lux at the keyboard or task surface for general workstation work. Seven hundred and fifty to a thousand plus for close inspection. That's the number that matters. Then you take the distance and the beam and you work back to how many lumens you need, and only then do you look at wattage, if at all.



Corn

For scale, what do typical fixtures actually put out?



Herman

A monitor light bar is roughly five hundred to a thousand lumens. A good desk lamp, eight hundred to fifteen hundred. Which is why the light bar, sitting thirty centimetres off the desk, can hit high lux from a modest lumen count. It's close. That's the whole trick.



Corn

And the dodge on wattage.



Herman

Listing only wattage, or "equivalent to a sixty watt incandescent," with no lumens anywhere. Or quoting lumens measured at the LED rather than at the fixture output, after the diffuser and the optic have taken their cut. That second one is subtle and common, because the number at the emitter is always the flattering one.



Corn

Wattage is the weakest proxy on the sheet. CRI is a stronger one, but it has a hole in it that most spec sheets are happy to leave open. Though first, settle the thing Daniel actually asked.



Herman

Ra is CRI. That's the answer. CRI is the concept, Ra is the specific metric, the average of R1 through R8, the eight pastel test colours. So Ra ninety five and CRI ninety five are the same number. Xiaomi using Ra95 is using the European and ISO notation, not a different scale.



Corn

So Daniel's instinct is right.



Herman

Completely right. Same metric, different notation. There's nothing sinister in the Ra label at all.



Corn

The sinister part is elsewhere.



Herman

The sinister part is what Ra averages. R1 through R8 are all unsaturated colours. Pastels. Ra says nothing about R9, saturated red. And R9 is exactly what matters when you're judging red wire insulation, or a solder joint, or a warm coloured component on a board. A lamp can boast Ra ninety five and have R9 near zero.



Corn

Which is not a hypothetical. That's a real product category.



Herman

It's most of the cheap high CRI claims you see. Fine for reading. Poor for identifying a red wire. And this is the point where I'd bring in the practitioner evidence, because there's a Hacker News thread from a few years back titled "Lament: Light Bulbs," and one commenter is insistent that he keeps halogen quartz desk and workbench lamps specifically for decoding resistor values. His argument is that even expensive brand spectrum LEDs weren't as good at that particular task.



Corn

A man hoarding halogens for resistor colour codes.



Herman

A man who is right about the specific thing he's right about. That thread captures exactly this. For component identification, spectrum quality at the work surface matters more than raw brightness. A brighter lamp that renders red badly is worse than a dimmer lamp



Herman (continued)

that renders it well.



Corn

Because the resistor bands are the whole point.



Herman

The fourth band is the tolerance. If you can't separate orange from red from brown, you can't read the component. That's not a luxury feature. That's the job.



Corn

So Ra is fidelity, not preference, and it's an average that hides its worst case. What's the modern metric?



Herman

TM-30, which reports Rf for fidelity and Rg for gamut, and it does it across ninety nine colour samples instead of eight. Plus IES R9 as a standalone, and CQS as an alternative. The practical signal is simple. If a spec sheet lists TM-30, that's a serious supplier. Almost nobody lists it for a reason.



Corn

And the targets.



Herman

General workstation, CRI or Ra at or above ninety, with R9 at or above fifty. PCB inspection and colour critical work, CRI or Ra at or above ninety five, R9 at eighty to ninety, ideally TM-30 Rf at ninety. That's the ladder.



Corn

Also in this bucket, and I think it deserves its own beat, flicker.



Herman

Flicker is the unlisted room mate of CRI. It's rarely on the sheet, it matters a great deal for close work and for anyone sensitive to it, and the honest indicators are a stated flicker percentage, or a frequency above three kilohertz, or straight DC dimming. If none of those appear, the sheet has told you nothing about it.



Corn

So that's what the sheet tells you about output and colour. The next two are the ones that decide whether you can actually live with the lamp. Kelvin, and the spec that doesn't have a name.



Herman

Kelvin is CCT, correlated colour temperature. Two thousand seven hundred is warm amber, four thousand is neutral, five thousand to sixty five hundred is cool or daylight. And the part that matters for Daniel's question is that higher Kelvin means more short wavelength content per lumen. It's the spectral lever.



Corn

Which connects directly to the circadian stuff we've been chewing on.



Herman

Directly. And the finding I'd put at the centre of it is this. Hartstein and colleagues in the Journal of Biological Rhythms, 2025, took preschool children and gave them one hour of twenty lux, at either two thousand seven hundred Kelvin or five thousand Kelvin. Melatonin suppression came out at roughly twenty four percent versus fifty six percent. Same intensity. Different spectrum. More than double the suppression.



Corn

Same lux, double the effect.



Herman

That is the cleanest recent demonstration that CCT is not cosmetic. It is not a mood setting. At equal intensity, the cooler light hits the circadian system materially harder.



Corn

Because of the melanopsin channel, the four eighty blue.



Herman

And there's a companion paper that sharpens it. Schöllhorn and colleagues, also in the Journal of Biological Rhythms, 2024, looked at commonly experienced evening levels, under ninety lux, and found that melatonin attenuation and the pupil response were driven predominantly by melanopic irradiance rather than luminance alone. Which is the basis of the melanopic EDI framing now turning up in lighting standards. mEDI. It's the number that actually predicts circadian impact, and it's almost never on a consumer spec sheet.



Corn

Now reconcile that with the thing we've said before, that blue light minimisation was overstated.



Herman

The honest synthesis, and I'd want to state it carefully because both halves are true. Intensity is the dominant driver. A bright warm light will suppress melatonin more than a dim cool light. That part stands. But Hartstein shows spectrum still matters a great deal at equal intensity. So you don't get to dismiss Kelvin. Intensity is the primary lever, Kelvin is a real and independent second lever.



Corn

Which lands exactly on why adjustable Kelvin plus granular dimming is the right design goal.



Herman

Because warm and dim as the night progresses attacks both variables at once. You don't have to choose between the levers. You can pull both.



Corn

Practical targets.



Herman

Four thousand to five thousand Kelvin for daytime focus work. Then dial down toward two thousand seven hundred to three thousand in the evening, and reduce the intensity with it. The feature to hunt for is adjustable CCT, tunable white. A fixed six thousand Kelvin daylight lamp is a fine morning lamp and a poor evening one.



Corn

And the dodge on Kelvin.



Herman

A single CCT quoted with no tolerance. No plus or minus anything, so you don't know if you're getting four thousand or four thousand four hundred. Claiming adjustable when it's three or four preset steps rather than a continuous range, which is the difference between a dial and a switch with extra positions. And CCT quoted without the corresponding mEDI value, which is the number that actually tells you the circadian load.



Corn

Kelvin is the spectral lever. The other lever is intensity, and that's where the unnamed spec comes in. Daniel's right that it barely has a consumer facing name.



Herman

It has industry names. Dimming range, or dimming ratio, printed like a ratio, a hundred to one, or a thousand to one. Dimming curve and resolution, linear versus logarithmic and how many steps there are. Minimum dim level, as in, dims to one percent.



Corn

So what's actually wrong with a lamp that just says dimmable.



Herman

A lamp that dims from ten percent to a hundred percent is close to useless for late night work. Ten percent of a bright task light may still be at one in the morning. The bottom of the range is the entire point, and it's the part nobody quotes.



Corn

Because the top of the range is the part that sells.



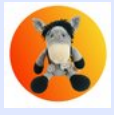
Herman

The top is what a showroom demonstrates. You walk in, they turn it to full, it's glorious, you buy it. You never find out what the bottom looks like until eleven p.m. on a Tuesday.



Corn

What should someone target.



Herman

A dimming ratio of a hundred to one or better. So the minimum is about one percent of full. Smooth, flicker free, with fine granularity at the low end specifically. That last clause matters because a lot of cheap lamps dim roughly linearly and feel all or nothing down at the bottom, three usable steps and then off.



Corn

And the mechanism question, because I know what's coming.



Herman

PWM versus constant current, or analog. Pulse width modulation dims by switching the emitter on and off fast and changing the duty cycle. At full brightness it's on constantly and there's no flicker at all. At low brightness the off periods become a meaningful fraction of the cycle, and depending on how it's driven, the flicker can become visible or at least physiologically active. So a lamp can be flicker free at the top and not at the bottom. Analog or DC dimming holds the current steady and reduces it, so the low end stays clean. For close work and for evening use, analog is the better choice.



Corn

Which is a spec almost nobody lists.



Herman

Almost nobody lists the dimming method at the consumer end. It's the marketing word "dimmable" doing all the work, and it's carrying nothing.



Corn

Other dodges.



Herman

A stated range that's only achievable through an app while the physical control is coarse. And dimming that also shifts CCT unintentionally, some cheap tunable lamps change colour temperature as they dim, so you reach for one lever and get two, and the second one isn't in your control.



Corn

Which brings us to the two profiles, and then the reason dental clinics keep turning up in this search.



Herman

Mixed workstation with occasional inspection. Three hundred to five hundred lux at the task. CRI or Ra at or above ninety. R9 at or above fifty. TM-30 Rf at eighty five if it's listed. Adjustable from two thousand seven hundred to five thousand Kelvin. Dimming at a hundred to one, smooth. Low or flicker free. Wide-ish even beam, because a mixed desk wants coverage more than concentration.



Corn

And the PCB bench.



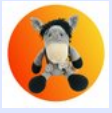
Herman

Seven hundred and fifty to a thousand plus lux. CRI or Ra at or above ninety five. R9 at eighty to ninety. TM-30 Rf at ninety. Adjustable CCT with a solid four to five thousand Kelvin available, because close inspection wants neutral to cool. Dimming at a hundred to one or better, flicker free, analog preferred. Narrower beam, high lux, low glare, because you want the light on the board and not in your eyes.



Corn

Which brings us to why dental clinics and nail salons keep turning up in this search.



Herman

Because those markets demand most of what Daniel wants, for reasons that have nothing to do with desks. Shade matching teeth, skin, and nail colour needs high CRI, and in practice Ra ninety five to ninety eight with strong R9. Clinicians tune CCT for looking at tissue versus judging colour. They need high, controllable intensity with fine dimming. And they often want shadow free focused optics with sealed wipeable heads, which is a genuine bonus on a workbench where you're doing messy things.



Corn

So as a source of high CRI, tunable, well diffused emitters, it's a legitimate hunting ground.



Herman

Legitimately under explored. The trade-offs are real though. Mains powered, bulky, priced for clinical budgets, and the optics are tuned for a patient's mouth or a hand rather than a three monitor desk. You're buying an emitter and re-homing it.



Corn

Last piece, and then we park it for next week. Geometry.



Herman

Lux is distance dependent by the inverse square. A spec sheet lumen figure tells you nothing until you know where the fixture sits. Monitor light bars sit close to the desk, so they give high lux from modest lumens, but the asymmetric optics concentrate that lux in a band rather than across the whole desk. A clamp arm trades desk space for flexibility.



Corn

And glare is the other half.



Herman

A high CRI, high lux lamp aimed badly creates veiling reflections on glossy monitors and on bare boards, and those reflections reduce effective visibility. So the best light on paper can be the worst light in practice if the beam goes the wrong way.



Corn

Your wobble observation about light bars, by the way, is a real and commonly reported trade-off. Space efficient and glare controlled, at the cost of mounting stability and a fixed position you can't move to the work. That's a fair trade for some desks and a bad one for others.



Herman

Which is next episode's problem. But it's why we kept saying conditional. Every number today is conditional on that.



Corn

Right. And one person who has a very specific opinion about the bottom of a dimmer range is sitting three feet from me.



Hilbert

The problem with a dimmer range is that the bottom end is not a brightness. It's a promise.



Corn

Go on.



Hilbert

I bought one, years ago. Desk lamp, advertised as dimmable. Took it home, switched it on low, and the low setting lit the whole room. Not dim. Just slightly less bright than the top. The knob had maybe thirty degrees of travel and everything useful was in the first two millimetres.



Corn

So the physical control was the bottleneck.



Hilbert

The control was honest. The lamp was the problem. There was no range. The box said dimmable and it was, technically, in the sense that it had a knob.



Herman

This is the exact gap we've been describing. Dimmable as a word, versus dimming range as a number.



Hilbert

Took it back. Bought a second one from a supplier that printed an actual ratio on the box. Hundred to one, or something close. I remember it because it was the only lamp in the shop that printed one at all, and it was small, down near the barcode, next to the model number. Nobody puts it on the front. Nobody.



Corn

Near the barcode.



Hilbert

And I stood there in the shop thinking, this is the number I need most and you've put it where you put the recycling symbol.



Herman

Which is a perfect illustration of the whole episode. The number that predicts how you'll actually live with the thing is the one buried at the back, behind the number that sells it.



Hilbert

I'd go further. Dimming granularity is the spec that separates a lamp you keep from a lamp you resent, because it's the one you touch every night. You read the CRI once, at purchase. You turn the dial every single evening.



Hilbert

Also the second lamp's driver whined at low levels. Audible. High pitched. I kept it anyway. Range was worth the noise.



Corn

And the level's still a bit hot on my side, when you get a moment.



Hilbert

I'll take it down two.



Corn

So. The number you need most is the one nobody prints on the front of the box.



Herman

Which is the whole shape of this. R9 is buried behind Ra. Dimming ratio is buried behind dimmable. mEDI is buried behind Kelvin. In each case the sheet gives you the flattering summary and withholds the operating number, and the operating number is the one you interact with.



Corn

Which raises a question worth sitting with. If the numbers that actually predict behaviour are the ones manufacturers bury or omit, what does that say about how lighting gets sold? How much of that spec sheet is written for the buyer, and how much of it is written for the shelf?



Herman

The shelf, mostly. You buy on the front of the box and you live with the back. And the gap between those two is where the returns counter gets its business.



Corn

Next week we take up fixtures. Monitor light bars, clamp arms, and why the same emitter behaves completely differently depending on where it sits and what optics it's behind. Everything we discussed today is conditional on that, and Daniel's wobble observation is the thread we'll pull.



Herman

Bring the halogen hoarder with you.



Corn

If you're enjoying the show, a review helps more than you'd think. Thanks, as always, to our producer Hilbert Flumingtop.



Herman

This has been My Weird Prompts.



Corn

The human-AI collaboration podcast. We'll be back soon.