

Response to the Review of Ecodesign Requirements for Lighting Products with regard to Entertainment Lighting



Association of Lighting Designers

www.ald.org.uk

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1. Introduction

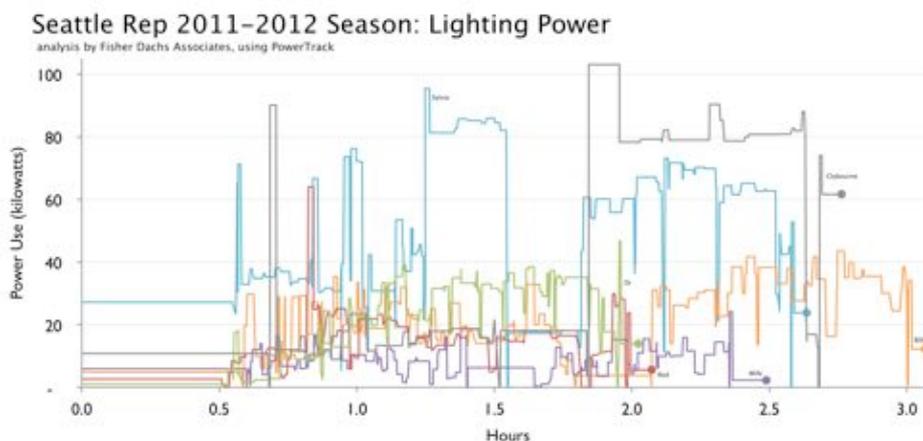
The Association of Lighting Designers (ALD) represents lighting designers and lighting technicians working in entertainment and performance lighting, with members from around the world. The Association has been involved, through the European Entertainment Ecodesign Coalition (EEEC) and Pearle, with all of the discussions about Ecodesign as it pertains to entertainment lighting throughout 2018, since it became clear that the proposed regulation would remove the existing, clear exemption for 'lighting applications where the spectral distribution of the light is adjusted to the specific needs of particular technical equipment in addition to making the scene or object visible for humans (such as studio lighting, show effect lighting, theatre lighting)' while imposing much higher efficiency standards that it would be impossible for many specialist entertainment luminaires to meet because of their particular optical design and performance requirements.

During this time, the ALD has always aimed to ensure that the views and concerns of lighting designers and lighting users (including venues that own and purchase lighting equipment, and productions and producers that rent or purchase lighting equipment for specific projects) have been represented alongside those of lighting manufacturers.

The ALD, on behalf of its members, fully supports the overall aim of the regulation: to reduce the energy consumption of lighting. In many cases, productions, performances and new venues for which the lighting has been designed or specified by ALD members are ahead of these regulations, adopting new high-efficiency luminaires (particularly LED luminaires) where they provide the functionality (including optical performance but also related factors, such as subtle fading, low operational noise and long-term reliability) required. However, vast stocks of older equipment is also still in active use. If the light sources many of these luminaires rely on (predominantly tungsten-halogen bulbs) were not allowed, these luminaires would quickly become scrap. If compliant new fixtures were not possible, there would be nothing to replace them with.

2. Consideration of Overall Environmental Impact

The ALD has always argued that consideration also needs to be given to the overall environmental impact of specialist performance lighting equipment. Such equipment generally has a very specific pattern of use: for the most part used only during performance times (usually just a few hours a day, usually just one or two performances a day), luminaires used at different levels and in different combinations to create lighting 'pictures' on stage or on camera and so very rarely with any of lights operating at full power or with all of the lights on at one time. Studies have demonstrated that performance lighting makes up less than 5% of a theatre's total power consumption. Further, studies have shown that the total power consumption for lighting one performance is just 15-25% of the total power that would be used if all of the lights rigged around the stage were just left on at full for the duration of the show - even when the lighting rig consists largely of the kind of tungsten-halogen lamp that the EU considers inefficient.



Power use by performance lighting across six shows in Seattle

<http://www.lightingandsoundamerica.com/reprint/EnvironmentStageLight.pdf>

https://www.london.gov.uk/sites/default/files/green_theatre_summary.pdf

Replacing tungsten-halogen luminaires used in this way with more efficient LED luminaires will undoubtedly give a reduction in power consumed, but not one of the scale expected from simplistic 'this new luminaire uses this much less power than this old one' calculations. Further, replacing existing luminaires, many of which have given good service for decades, would lead to those luminaires becoming scrap, which is highly wasteful. It would also often require the replacement of the support infrastructure (dimming, power, control) in the venue, leading to further expense and the creation of further waste. All of this is contrary to the EU's 'Circular Economy' initiative which seeks to minimise waste. Just updating existing luminaires with LED replacement bulbs is not possible because almost no suitable LED replacement bulbs are available that would work within the physical and optical design of existing luminaires. The very few that are available do not offer the same performance characteristics as existing lamps, particularly in terms of light output and the ability to be dimmed smoothly. Plus all such infrastructure updates are expensive, in some cases unaffordable by venues particularly where they will not see suitable financial payback from reduced power consumption.



Performance lighting: War Horse, An Inspector Calls, Eurovision Song Contest

The ALD has never suggested, and is not now suggesting, that entertainment lighting should be exempt from regulation just because it is somehow 'art' or 'special'. However, the ALD would present the case that entertainment lighting - theatre, concerts, live events, film and television - makes use of light in quite different ways from general service lighting and illumination. Carefully considered choices are made as to the placement of luminaires, the colour of the light emitted from those luminaires, and the level at which and time for which those luminaires operate all in the service of the productions being lit, whether those be plays, musicals, operas, concerts, corporate conferences, film shoots, live or recorded television productions or other types of show. Lighting in this application is designed by experts who understand and care deeply about the quality of light by any number of measures, including but not limited to colour rendering, colour quality, fade quality and beam field quality as well as, in many cases, the operating noise and long-term reliability of the luminaires themselves.

Those experts are often also artists who care about light in a way beyond the usual technical parameters: about its 'feel', about the 'mood' it can create, about the visceral reaction it can induce in an audience. Those factors are hard to measure but have palpable, demonstrable effects: watch an audience rise to its feet cheering as light sweep out to them in a rock concert. Watch as an audience is moved to tears as the lighting subtly shifts the mood of the stage colder and harsher around the death of a leading character. To those who use lighting as their tool, these factors, and the subtleties that define them, are often more important than lumen output or colour temperature.

Specialist entertainment luminaires are the tools these specialists use to create their work, tools having particular parameters designed to satisfy the needs of their application. Trying to prescribe the same efficiency standards for such luminaires as for domestic/industrial luminaires is as problematic as it would be trying to apply the same miles-per-gallon figure to a commercial truck designed to carry heavy goods loads as to a family car - similar concept (engine, wheels), quite different application and purpose. More useful, surely, would be trying to encourage overall improvements in efficiency across every sector keeping in mind each sector's functional requirements, rather than trying to achieve the physically impossible task of making every sector hit the same numerical target. And, for lighting, ideally creating overall efficiency improvements without diminishing *any* of the qualities of the light.

3. Current Ecodesign Proposals

All that said, the ALD is pleased to note that the regulation as currently proposed (as of October 2018) does avoid the situation that seemed possible earlier in the year where all tungsten-halogen entertainment luminaires would quickly be rendered obsolete but no compliant LED fixtures would be available to replace them.



Source Four Tungsten, Source Four Lustr2 LED Spot luminaires; Lustr2 LED array

On behalf of its members, the ALD is grateful exemptions have been provided for many of the tungsten-halogen light bulbs used by entertainment lighting (theatre, film, concerts, music, television), and for the kind of colour-tunable LED luminaires that the entertainment lighting industry has been adopting. This will continue to allow venues that own stocks of tungsten equipment to continue to use them, and so continue to allow lighting designers to make use of their unique properties, particularly their excellent fade characteristics, high quality colour rendering, silent operation, high reliability and low overall running costs, in productions of all types. The exemption for colour-tunable light sources, with the provisos noted below about standby power and the definition of green, will also allow the ongoing development of high quality, versatile LED replacements for these tungsten luminaires, so that more users, venues and shows can adopt this type of technology as funding is available, just as new venues and shows are already doing.

4. Outstanding Issues In The October 2018 Draft

However the ALD, along with other members of the Pearle-led European Entertainment Ecodesign Coalition, remains concerned about a number of issues that were introduced in the June draft of the regulations and which have not been addressed in the October draft despite repeated attempts by the entertainment lighting industry, through Pearle, to raise its concerns about these issues.

The issues are:

a) The 0.5W standby power requirement. This appears to mean that when luminaires are not emitting light, they must consume 0.5W or less of power. This is virtually impossible for modern entertainment luminaires which have built-in control electronics that constantly listen to incoming control data transmitted in a specialist entertainment lighting control protocol such as DMX512, E1.31 s-ACN, Art-Net, Pathport, ShowNet, ETCNet or a number of others.



Source Four Lustr2 luminaire Control Interface and Processor

A technique commonly used to achieve this kind of very low standby power consumption in electronic equipment is for the control electronics to go into a 'deep sleep' mode and only scan for control signals intermittently, say every second. This is why users often have to press-and-hold the 'on' button on their television to wake it from standby mode. In contrast, professional entertainment luminaires have to be ready to react immediately - for example, coming to full output immediately in time with a 'crash' in the music. A delay of even a fraction of a second would be intolerable; it would mean the luminaires were not able to achieve one of their key functions, reacting in time to a live performance. This means such luminaires are unable to adopt this kind of 'deep sleep' technique; the general consensus of manufacturers is that they will therefore be unable to meet this standby power requirement for any luminaire with this kind of control electronics, which would be any and all luminaires using LED sources.

While the ALD understands that the measurements prescribed are only intended to be for the light source, in many cases the light source will be inseparable from the control electronics for testing purposes. The ALD suggests that either the standby power requirement needs to be higher for entertainment luminaires to recognise this particular specialist performance requirement (perhaps with a standby power limit of the order of 5 to 10W), or that such luminaires be exempted from this requirement. Alternatively the regulation needs to make it absolutely clear that the requirement is only for the light source itself regardless of how difficult it may actually be to control the light source independently of its control electronics for testing purposes.

It is worth adding that when entertainment lighting rigs are not actively in use - ie. outside of performance times - they are usually switched off entirely, completely isolated from the incoming mains. Allowing a slightly greater standby power would not lead to as great an increase in power consumption as it would at first appear, since for the majority of the day (for a single performance day, perhaps 20 hours of the day) the lighting rig would be entirely switched off and so drawing no power at all.

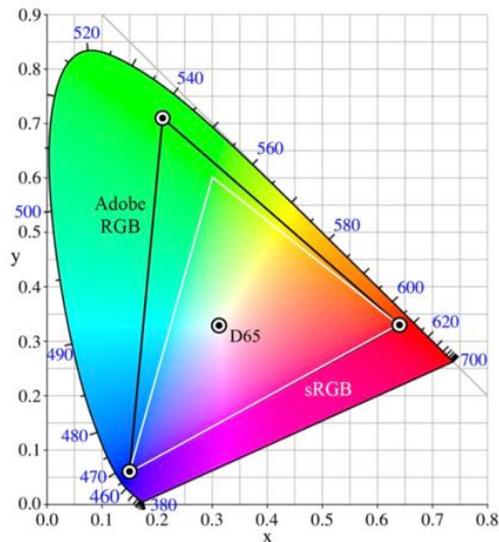
b) High-output white LED luminaires. Manufacturers suggest that high light output (ie. high power) white LED sources would not be able to meet the prescribed efficiency standards, because of the Auger effect (whereby high-power LED sources become less efficient than low-power LED sources because they are operating at high currents and high temperatures), étendue (where light collection becomes less efficient as light sources become physically larger) and related issues. Because of these issues the light output of LED sources does not scale proportionally to power - a 200W LED source cannot now and probably will never be twice as bright as a 100W LED source. As an example, a state-of-the-art LED array light source manufactured by Appotronics and designed to work in luminaires with a focusable optical system operates at 500W and outputs 28,000 lumens at just 56lm/W. This is considerably below the required standard which is approximately 75-80lm/W (the required value varies slightly depending on the colour quality and some other factors of the light source).

No account is taken of these issues with high power/high light output sources in the regulation's efficiency (P-onmax) calculation. This leaves a wide band of high-output LED light sources, including many used in current and upcoming theatrical lighting luminaires, unable to meet the efficiency standards. Since they are not very-high output (greater than the regulation's 82,000 lumen upper limit), they would therefore not be permitted by the regulation.

This would prevent manufacturers from creating high-output luminaires with white light LED sources, even those where colour mixing functionality was then provided using subtractive colour mixing via remotely controlled colour flags. If these luminaires were not available on the market, users requiring equipment of this brightness would continue to use luminaires based around high-output arc-light (discharge) sources, which are exempt on other grounds. The irony here is that these luminaires are dramatically less efficient than the (not allowed) LED alternatives in real world use: because they cannot be dimmed electronically, they are dimmed by mechanical means and so are still consuming their full power even when zero light is being emitted. This is surely against the spirit and intent of the regulation.

The efficiency definition (the P-onmax calculation) includes correction factors for a wide range of other special cases. It would seem trivial to add a similar correction factor to allow for the complexities and fundamental scientific limitations of designing high-output LED light sources.

c) The definition of green within colour-tuneable light sources.



The regulation's definition of green does not include the peak green sensitivity of 555nm, and the purity requirement for green light is very tight. The specification used is possibly one intended for image display devices (sRGB colour space, IEC61966-2-1) which is not necessarily appropriate for luminaires. The very tight requirements would appear to limit a luminaire manufacturer's ability to decide on the trade-offs between gamut, purity and the rendition of pastel colours. The definition could also favour particular LED source manufacturers over other LED source manufacturers, which would seem to be anti-competitive. The ALD, as others are also doing, proposes that the range for Green light be extended to cover 520nm-570nm.

The ALD notes that a new generation of red LEDs using phosphor conversion techniques are due to appear on the market soon. These are likely to fall outside the regulation's definition of red light, creating a similar problem. The ALD considers that the way these colour-tuneable light sources are being defined is generally too prescriptive, with little or no allowance for luminaire design choice or future technological developments.

d) Specialist lamps used for entertainment lighting. The June and October drafts of the regulation include exemptions for just 17 specialist lamp bases used predominantly or entirely in entertainment lighting, from 49 requested by the entertainment lighting industry. The ALD fully supports the request in the Pearle response document to exempt additional lamp bases which are used largely or entirely in entertainment lighting:

https://www.ald.org.uk/sites/default/files/resources/PEARLEecodesignlightingamendmentproposal_15102018.pdf

This would include an exemption for low voltage (24V) crown-silvered tungsten or tungsten-halogen lamps in the 250-1000W range using K39d and E40 lamp bases, used in very specialist luminaires such as beam projectors and narrow angle battens ('Svoboda' battens, named for the famous Czech scenographer who first created them).



24V Beamlight;



Svoboda Batten,



Svoboda Batten close-up

No suitable LED replacements are available for these lamps as used in these kind of luminaires, considering their narrow-beam optical performance, fade quality, colour shift to warm on fade and the requirement for the lamp to operate within the physical and optical design of existing luminaires that were designed very specifically and precisely around these kinds of tungsten lamps.

The ALD notes that in Annex III of the regulation, it is detailed that “light sources with a beam angle of less than 10° and intended for spot-lighting applications requiring a very narrow light beam” are exempt from the regulation. Used in conjunction with an external reflector to complete the optical system, this is exactly the application of these low-voltage crown-silver lamps.

The ALD also notes that in the current discussions about regulating lighting in Australia/New Zealand, an exemption is included for this type of crown-silvered lamps, recognising their special optical parameters (*E3 Equipment Energy Efficiency Decision Regulation Impact Statement: Lighting*, p118):

https://ris.pmc.gov.au/sites/default/files/posts/2018/05/lighting_decision_ris.pdf

The Pearle document also includes, and the ALD supports, an exemption for T5 and T12 fluorescent tubes optimised for use in film and TV production. While LED equivalents of these luminaires are available, they are much more expensive than the fluorescent equivalents, and are not dramatically more efficient than the fluorescent versions. Such luminaires are typically used in large quantities in specialist applications such as lighting green-screen environments for special effects filming. Forcing the use of substantially more expensive LED luminaires would potentially lead to the overall cost of filming such movies becoming much higher within the EU than outside of it; most film production work is transient and happy to locate to wherever costs are lowest, which could lead to a dramatic reduction in employment on such projects within Europe. The power saving of LED fixtures over fluorescent fixtures in this application is also not likely to be enormous.

The ALD also notes the issue with R7 tungsten-halogen lamps in the June and October draft of the regulation.

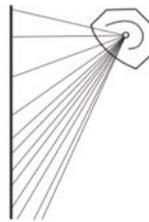


R7 tungsten-halogen lamp

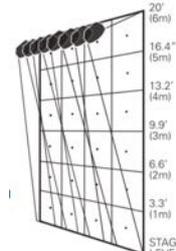
This exempts R7 lamps of less than or equal to 2700 lumens while banning R7 lamps of greater than 2700 lumens. Given that LED replacement R7 lamps are available at less than 2700 lumens (eg. Philips CorePro LED linear D 14-120W R7), but are not available at greater than 2700 lumens, it feels like the regulation has a '<' (less than) sign where they perhaps intended to have a '>' (greater than) sign.



Coda-1 asymmetric floodlight;



beam distribution;



lighting a cyclorama

Entertainment lighting makes use of R7 lamps in specialist floodlight luminaires with a strongly asymmetric light output distribution, designed to evenly light large scenic backcloths or skycloths / cyclorama with the light source at the very top or bottom of the cloth. The lamp mounting specification for the R7 lamp base and the optical design of these luminaires make it impossible to design a drop-in replacement LED lamp even if it were possible to manage the thermal issues of such a light source in a luminaire not originally designed to house such a light source.

The ALD will note that massed floodlighting of cloths constitutes one of the largest uses of electricity in theatre lighting. Many theatres that own stocks of lighting equipment and have found funding to upgrade that equipment stock have made their first investment in LED lighting in equipment for lighting skycloths because this investment generates the most rapid payback in terms of electricity saved. However, there is a massive stock of R7-based equipment in use, and to force its rapid replacement (particularly when many LED replacements lack the fade subtlety of the tungsten equipment and are also an order of magnitude more expensive than the existing tungsten equipment) will be problematic. The lower running costs of LED luminaires means that as suitable products become available at a suitable price, this area will sort itself out relatively quickly without the 'strong hand' of regulation attempting to force the change in an unrealistic timescale (which may result in the forced adoption of ultimately unsuitable equipment which would then in turn need to be wastefully replaced).

The ALD would suggest that R7 lamps of all light outputs be exempt or given a dramatically longer phase-out period. For comparison, the same Australian study referenced above will provide exemption for all R7 lamps because of the problem of obtaining retrofit LED lamps and because users who can embrace LED alternatives are already actively converting (*E3 Equipment Energy Efficiency Decision Regulation Impact Statement: Lighting*, p117).

Generally for these specialist light sources, the ALD notes that the Ecodesign principles state that if there are no suitable replacements for certain lamp types on the market, or if higher energy efficiency alternatives are not cost-effective, exemptions should be given. For the artists who use light as a malleable medium and consider every aspect of the light as part of their design, no suitable LED replacements are available for the lamp types noted above. For the technicians who have to make the light work, no suitable LED replacements are available because LED replacement lamps with the same lamp base types are not smoothly or reliably dimmable, would not work within the optical design of existing luminaires, may not actually fit in the existing luminaires, and would in any case exhibit different performance characteristics, including a fixed colour temperature rather than the variable 'red-shift' colour temperature that tungsten sources exhibit as they are dimmed. LED replacements even when notionally available based on their lamp bases are not *suitable* replacements.

5. Conclusion

The ALD would strongly urge the EU to give due consideration to these four outstanding issues, just as it gave due consideration to the issues brought before it by the European Entertainment Ecodesign Coalition at a meeting in May. If these important issues are not addressed, they seem likely to give rise to either manufacturers 'working around' the regulations, which seems to run counter to the aim of these updates, or to manufacturers being unable to produce new versions of these very specialist entertainment lighting tools in a way that complies with the regulation at all.

If no suitable tools are available to encourage users to invest in and move to more efficient tools, they would have no choice but to continue to use existing, less efficient but exempt tools, possibly stockpiling lamps, or grey-importing them from other parts of the world.

This would likely lead to a crisis in the future as the adoption date approached for the next round of Ecodesign regulation. The EU has indicated and the ALD understands the intent is to remove specialist exemptions and finally remove any exemptions for tungsten-halogen light sources. If under the proposed (2021) regulatory regime manufacturers had been unable to produce suitable, compliant replacement products, that would leave theatres and shows unable to use their existing tools but with no suitable new tools available to them. This would inevitably lead to the need for further ongoing exemptions, just kicking the problem further down the line.

The ALD is now strongly encouraging all that engage with it on this subject not to continue with 'business as usual' even though the exemptions in the current regulations would allow that for entertainment lighting in many cases. Rather, it is warning them that they have to start planning for change - and finding the funding to invest in such change - over the next five year regulation cycle. It thanks the EU for providing exemptions that give the entertainment industry time to make these changes in an orderly manner.

However, the ALD does note that entertainment lighting will now be governed by the complex overlaps of a number of different exemptions rather than the very clear exemption for "studio lighting, show effect lighting, theatre lighting" that exists now. Sector-based exemptions are provided in other areas (for example, marine and rail applications). The EEEEC has provided examples of ways that luminaires used for entertainment lighting could be identified. The ALD would ask once more for consideration to be given to this approach for specialist entertainment lighting equipment, recognising its particular requirements and use patterns.

If this approach is not possible, the ALD does respectfully ask that the final key details in the proposed regulation, identified above, be resolved in order to ensure that suitable specialist lighting tools for the entertainment industry that do the jobs that need to be done while also meeting the regulations can actually be created. Resolving these issues would also ensure that these particular needs and functional requirements are clearly understood when discussions start on the next round of these regulations.

Time is certainly tight to make these changes. But better, surely, to get it right for the future than just to get it done by an arbitrary deadline.