

# ECO design regulations

## 2<sup>nd</sup> draft, a summary review.

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Version 4

Following the publication of the 2nd Draft Regulation by the Commission. Adam Bennette has provided his interpretations summarising what the Exemptions could technically mean. Please be clear that this is not a definite outcome, it is an interpretation to aid understanding. There has been comment that some of the lamps are still being debated.

## EXEMPTIONS

### Introduction

Basically there are seven types of exemption that affect our industries:

- Lamp base list
- Absolute brightness
- Point-source brightness
- Beam angle
- Color mixing ability
- Exempted due to use in other exempted industries
- R7 linear lamps with high output.

### Definitions and scope

Mantra: this regulation applies to light sources alone and not to luminaires.

A light source is carefully defined, although room remains for interpretations.

Simplistically a light source is the moral equivalent of a lamp. In some cases this is too simplistic and the regulation definitions must be carefully analyzed to decide where the light source stops and the luminaire begins.

The regulation is NOT retrospective. All products, whether luminaires or light sources, already in the market (including on the shelves of distributors) remain legal to sell up to and to use beyond the enactment date of the regulation, currently set at September 2021.

The lamp voltage is not relevant, the regulation applies to any light source connected to the mains whether or not via a voltage convertor or driver.

Battery powered lights including mains rechargeable types are exempt.

The EU's own text uses the following definition in one place. We should adopt this and make sure to specify it every time we talk about 'our industries':

*Scene lighting use in film studios, TV-studios, and photographic-studios, or for stage-lighting use in theatres, discos and during concerts or other entertainment events.*

## The lamp base list

The exemption is given by the type of base, which is defined primarily by the pin spacing.

Any tungsten lamp type sitting on top of an exempted base is exempted regardless of its characteristics such as voltage, power, brightness, colour temp, service life and so on.

These base types are exempted:

G9.5	GX16 (PAR)	GX38Q
GX9.5	GX16D (PAR)	P28S
GY9.5	GY16	P40S
GZ9.5	G22	PGJX50
G9.5 HPL	G38	QXL
G16D	GX38	

## Cross reference, base type to model ref:

For information, this list does not appear like this in the draft regulation, only the base types are mentioned.

ANSI code	T, P or CP number	Base	Wattage	Notes / Examples
FVC	CP23	<b>GX9.5</b>	650	HighTemp version of T12
FVA	CP24	<b>GX9.5</b>	1000	HighTemp version of T11
	CP30	<b>GX38Q</b>	1250/1250	Twin filament studio light
	CP32	<b>GX38Q</b>	2500/2500	Twin filament studio light
FKH	CP39	<b>G22</b>	650	650 Studio Fresnels & Profiles
FKJ	CP40	<b>G22</b>	1000	1000 Studio Fresnels & Profiles
FKK	CP41	<b>G38</b>	2000	2000 Studio & Stage Fresnels
FTL	CP43	<b>GY16</b>	2000	2000 Stage Fresnels & Profiles

<b>ANSI code</b>	<b>T, P or CP number</b>	<b>Base</b>	<b>Wattage</b>	<b>Notes / Examples</b>
	CP58	<b>GX38Q</b>	1250/2500	Twin filament studio light
EXC	CP60	<b>GX16D</b>	1000	PAR 64 240V VNSP
EXD	CP61	<b>GX16D</b>	1000	PAR 64 240V NSP
EXE	CP62	<b>GX16D</b>	1000	PAR 64 240V MFL
	CP70	<b>GX9.5</b>	1000	Biplane version of CP24
	CP71	<b>G22</b>	1000	Biplane version of CP40
	CP72	<b>GY16</b>	2000	Biplane version of CP43
	CP73	<b>G38</b>	2000	Biplane version of CP41
	CP75	<b>G22</b>	2000	Biplane version of CP55, Bambino 2K?
FEL	CP77	<b>GX9.5</b>	1000	120V
	CP86	<b>GX16D</b>	500	PAR 64 240V VNSP
	CP87	<b>GX16D</b>	500	PAR 64 240V NSP
	CP88	<b>GX16D</b>	500	PAR 64 240V MFL
FRM	CP89	<b>GY9.5</b>	650	650W for small studio & location spots
	CP91	<b>G22</b>	2500	2500W for large stage& location fresnels
	CP95	<b>GX16D</b>	1000	PAR 64 240V WFL
DXX	P2-13	<b>R7S-74.9mm</b>	800	RedHead film light etc
FWP	T11	<b>GX9.5</b>	1000	1K Fres & Profile
	T12	<b>GX9.5</b>	650	Down-rated 1k fittings
FKB	T13	<b>P28 / P28S</b>	650	Old 650 Fresnels/Profiles, probably obsolete
FKD	T14	<b>P28 / P28S</b>	1000	Pattern 223 Fresnel, probably obsolete
FKE	T15	<b>P28 / P28S</b>	1000	Pattern 263/4 Profile
	T16	<b>P40</b>	500/1000	Pattern243 &252@ 1K, 93, 58, Probably obsolete
FKF	T17	<b>P28 / P28S</b>	500	Pattern 23, 123, 803, probably obsolete
GCW	T18	<b>GY9.5</b>	500	Modern 500W Profiles & Fresnels
FWR	T19	<b>GX9.5</b>	1000	As T11 but Biplane
	T20	<b>P28 / P28S</b>	1000	As T14 but Biplane
	T21	<b>GX9.5</b>	650	As T12 but Biplane
	T22	<b>P28 / P28S</b>	650	As T13 but Biplane
	T24	<b>P28 / P28S</b>	500	As T17 but Biplane
	T25	<b>GY9.5</b>	500	As T18 but Biplane

ANSI code	T, P or CP number	Base	Wattage	Notes / Examples
GCS	T26	<b>GY9.5</b>	650	Modern 650W Profiles & Fresnels
GCT	T27	<b>GY9.5</b>	650	As T26 but Biplane
FWT	T29	<b>GX9.5</b>	1200	Modern 1200W Profiles & Fresnels
	T30	<b>G22</b>	1000	
	T31	<b>G22</b>	1200	
GKV		<b>G9.5</b>	600	UK Profiles, Brio, SL, Freedom
HPL		<b>G9.5 HPL HeatSink base</b>	575	Source Four
HPL		<b>G9.5 HPL HeatSink base</b>	750	Source Four
HPL		<b>G9.5 HPL HeatSink base</b>	575-XL	Source Four
HPL		<b>G9.5 HPL HeatSink base</b>	750-XL	Source Four
FFP		<b>GX16D</b>	1000	PAR 64 120V NSP
FFR		<b>GX16D</b>	1000	PAR 64 120V MFL
FFS		<b>GX16D</b>	1000	PAR 64 120V WFL
FNN		<b>GX16D</b>	1000	PAR 64 120V VNSP
		<b>PGJX-50</b>	1200	80V. OSRAM Lok-It 1200W 80V/32/P50 for Martin TW1
QXL		<b>QXL</b>	750	Source Four Revolution
		<b>R7S - 117.6mm</b>	400	
		<b>R7S - 119.1mm</b>	800	
FEX		<b>R7S - 138.1mm</b>	2000	Blonde Film light etc.

## Absolute brightness

All light sources of more than 82,000 lumens output are exempt.

In practice this equates to around 3.5kW tungsten and 1kW discharge. So, for example, a 5kW tungsten lamp and a 1.2kW HMI are both exempted by this means, and of course all higher powers.

## Point-source brightness

Light sources with a radiance or surface brightness of more than 500 lumens per mm<sup>2</sup> are exempted. This is relatively easily determined. The regulation contains diagrams of source types and how to measure the light emitting surface area.

In practice this exempts all short-arc discharge sources and many if not all medium output discharge lamps such as 575W MSR, however for a particular lamp you should make the calculation to check.

## Beam angle

Any lamp or light source producing a beam of 10 degrees angle or less is exempt.

In practice this will exempt some narrow-angle MR16, pinspots, possibly some types of AR111 and Aircraft landing lights.

Note: this exemption is for a naked lamp that cannot be further dismantled, such as a Pre-aligned reflector lamp.

## Color mixing ability

This exemption is curiously devised: Instead of providing a simple exemption for professional colour changing luminaires, as requested, the EU have devised a definition of what a 'color tuneable' light source is.

If the source can produce particular shades and purities of the three primaries, red, green and blue then it is wholly exempted, regardless of any other colours it may be able to produce.

The definitions for blue and red are conventional and easily met by all common color-mixing lights. The definition of green is highly restricted, apparently deliberately so as to exclude lime from the exemption and may give rise to problems with a few designs, notably those that use Red, Lime & Blue recipes.

Note that again it is the light source that is regulated. A white light source with colored filters or dichroics mounted separately cannot enjoy this exemption.

Variable white light sources, e.g. 'fade to warm' or 'cool/warm' are not considered to be 'color tuneable' and are not exempted.

## Exempted due to use in other exempted industries

Light sources, lamps, used for these purposes are exempt:

**Military, Road vehicles, Aircraft, Railway vehicles, Marine equipment, Medical devices**

## R7 linear lamps with high output.

R7-type linear double-capped lamps, with two caps of 7mm diameter, above 2700 lumens output are exempted. This corresponds to a power of around 200W or less.

Thereby, the lamps used in Blondes, Redheads, Space lights, Soft lights and Cyc lights in our industries are exempted.

# REQUIREMENTS

Anything not exempted must comply with the following basic requirements.

These are the big-ticket items that will challenge our industries:

- Standby Power and Network Standby Power
- Luminous efficiency when applied to very high output LED arrays

## Standby Power

Standby power and network standby power are two definitions of the same basic limit:

- The light source must consume less than 0.5W when no light is being emitted.

This requirement is both difficult to meet and difficult to correctly interpret and apply to a product. The 0.5W is intended to be the part due to the operation of the light source alone with all other 'things' turned off, disabled or disconnected.

In practice complete separation of the electrical functional sections is often not possible, and particularly where a single power supply feeds various sub-systems including the light source driver in a complex luminaire, e.g. a moving light.

The regulation text appears to take this into account with unsatisfactory loose language: "...power consumption shall be minimized ...".

Of course, large luminaires cannot comply with 0.5W Standby – there may be motors holding position – but it is not the luminaire that must comply.

In theory a surveillance authority would demand to remove the light source and driver and verify the Standby Power.

## Luminous efficiency

The minimum efficiency allowed is around 75-90lm/W. It is not a single precise value and must be calculated according to:

$$P_{onmax} = C * (L + \Phi_{use} / (F * \eta)) * R$$

Where:

$P_{onmax}$  = Maximum allowed wall power consumption.

C = Light source correction factor

$$C = Table\ 2(type) + Table2Bonus(type)$$

For mains directional sources (DLS), C = 1.23

L = End loss factor:

$$L = Table1(type)$$

For LED directional light source,  $L = 2$

$\Phi_{\text{use}} =$  Useful luminous flux (in lumens)

$\Phi_{\text{use}} =$  Declared useful luminous flux (manufacturer's measurement and declaration)

The light source flux, total lumens

$F =$  Efficacy factor

*Non. directional,  $F = 1.0$*

*Directional, 120 degree cone,  $F = 0.85$*

*Directional, 90 degree cone,  $F = 0.56$*

$\eta =$  Threshold efficacy

$\eta = \text{Table1}(\text{type})$

for LED sources  $\eta = 120$

$R =$  CRI factor:

$R = (CRI + 80) / 160$

For CRI = 80,  $R = 1$

Tables are found in Annex II

Example LED light source:

- 10,000 lumens,
- CRI=90
- Directional 120 degrees

$$P_{\text{onmax}} = 1.23 * \left( \frac{2 + 10,000}{0.85 * 120} \right) * \left( \frac{90 + 80}{160} \right) \sim 128W$$

$$\frac{Lm}{W} = \frac{10,000}{128} \sim 78Lm/W$$

The limit given is achievable now for low power white sources. Some modern commercial and household lamps and LED light sources achieve nearly double the minimum efficiency.

However, as power is increased, and power density is also increased, the achievable efficiencies diminish. Typically at maximum allowed dissipation LED dies produce 80% of the stated efficiency at their optimal operating point. In the example the 78Lm/W becomes 63Lm/W. Another way to look at it is this: Very high power sources consume 25% more power, relatively to a source running at low power, for a given lumen efficiency.

Large area arrays rated at hundreds of watts and higher do not currently get at all close to the required minimum efficiency.

## Labelling

New labelling will be needed on all products

## Technical documentation

New technical documentation will be needed for all products

## Light source removability

Light sources should be removable if at all possible. This does not need to mean by the end user. If the manufacturer can remove the light source for measurement it must be measured. If the source cannot be removed without causing damage then the smallest demountable part which emits light must be measured, and if that includes any optics will in most cases result in a miserable fail for efficiency.

# SURVEILLANCE

Spare a thought for the surveillance authorities armed with their integrating spheres and spectrometers. Dashing from place to place on their unicorns to open up our equipment and find it lacking.

Fittingly, for the standby power measurement the light source must be 'cut off from the breast' of the luminaire without a 'drop of blood' of the rest of the body being included.

Thus would have argued Portia... (Merchant of Venice Act IV, Scene 1).

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