

EcoProfile 070924 CFLi

Compact self-ballasted Fluorescent Lamps (CFLi) for General Lighting Applications

1. Definitions

Compact Self Ballasted Fluorescent Lamps

Compact self-ballasted Fluorescent Lamps (**CFLi**) shall comply with:

- IEC/EN 60968 "Self-ballasted lamps for general lighting services - safety requirements"
- IEC/EN 60969 "Self-ballasted lamps for general lighting services – Performance requirements".
- Lamp caps shall observe the requirements of the international standard IEC/EN 60061 "Lamp caps and holders together with gauges for the control of interchangeability and safety."

In addition with the electromagnetic compatibility standards:

- CISPR15/EN 55015 "Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment."
- IEC/EN 61000-3-2 "Limits for harmonic current emissions (equipment input current $\leq 16\text{A}$ per Phase), limits for class c equipment – see 7.3.1 Lighting equipment paragraph a and b."

Active power $> 25\text{W}$ and active power $\leq 25\text{W}$.

- IEC/EN 61547 "Equipment for general lighting purposes – EMC immunity requirements".

Compact self-ballasted fluorescent lamps (**CFLi**) are specified in following segmentation families (shapes):

- **Segment A** - Non-covered CFLi types.
- **Segment B** – Covered CFLi types.
- **Segment C** – Reflector CFLi types.

General Lighting

General Lighting Lamps are lamps for general use in private, commercial & industrial application areas with the following characteristics:

- General Lighting sources provide a level of visible light in the range of 400 to 800 nm.
- Most of these are classified by the energy label (Energy Label Directive 1998/11/EC) and are universally available.
- These lamps shall comply with the relevant legislation. Which are, but not limited to the following:
 - CE Mark (98/34/EC)
 - General Product Safety Directive (2001/95/EC);
 - Electromagnetic Compatibility Directive (2004/108/EC);
 - Low Voltage Directive (2006/95/EC);
 - Energy Using Product Directive (2005/32/EC);
 - Waste of Electrical Equipment Directive (2002/96/EC); and
 - Reduction of Hazardous Substances Directive (2002/95/EC)
- Lamps which are not for general lighting are listed in *Annex 3*.

For general lighting applications it is only possible to use lamps based on the standards IEC/EN 60968 and 60969.

2. Minimum Performance Standards

2.1 Candela

Candela (cd) is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.

2.1. Efficacy Standard

Efficacy (lm/W) is the amount of light emitted measured in lumen (**lm**) by a lamp for each Watt (**W**) of power consumed. The efficacy is the key indicator for efficient power consumption.

For Segment A and B Lamps:

The minimum lumen per wattage values is outlined in *Annex 1*.

For Segment C Lamps:

CFLi reflector lamps are measured in lm/W, and this measurement method is still under consideration by the ELC.

This is outlined in *Annex 2*.

2.2 Efficacy Maintenance

Efficacy maintenance is the efficacy at a given time in the life of a lamp expressed as a percentage of the measured efficacy at 100 hours.

The efficacy maintenance at 2,000 hrs is listed in *Annex 1*.

2.3. Colour Rendering Standard

Colour Rendering (Ra) is the ability of lamps to render colours faithfully is measured on the Ra index. The index runs from 20 (indicative of severe colour distortion) until 100 (no colour distortion).

For General Lighting Applications the Minimum Colour Rendering (Ra) should be ≥ 80 , in accordance to EN 12464-1 for indoor lighting.

Efficacy of lamps with a $Ra \geq 90$, should not be less than 85% of lamps with $80 \leq Ra < 90$.

2.4 Power factor.

Power factor is defined as the ratio of the measured active input power to the product of the supply voltage (rms) and the supply current (rms).

For lamps claiming to be 'High Power Factor' – the power factor shall not be less than:

- 0.85 for lamps $\leq 25W$; and
- for lamps $> 25W$ refer to the harmonic standard (EN 61000-3-2).

For lamps claiming to be 'Low Power Factor' – the power factor shall not be less than 0.5.

Measured values of power factor shall be provided upon request.

2.5 Lamp Life

The **life of an individual lamp** is the length of time to which a complete lamp operates to burn-out or to any other criterion of life performance laid down in the standard IEC/EN 60969.

The **average life** is the length of time during which 50% of the lamps reach the end of their individual lives.

This shall be a minimum of 6,000 hours using the same sample size as defined in *Annex 4*.

3. Testing requirements and conditions for the Minimum Performance Standards

The testing requirements and conditions to meet the minimum performance standard are described in *Annex 4* (based on standard EN 50285).

4. Lamp performance Standards

For CFLi Lamps in the European market, the minimal efficacy requirement listed in *Annex 1* should be added as an additional criteria to apply the CE mark.

Relevant performance standards for CFLi reflector lamps are currently being developed. The existing standard for GLS Reflector Lamps (EN 61341) does not apply to CFLi reflector lamps. These measurement values are significantly lower than normal GLS reflector lamp values.

Lamps listed in *Annex 3* (for special applications, generally low volumes) are exempt from this rule.

5. Control gear

In contrast to Non Ballasted Single Capped Compact Fluorescent Lamps, CFLi Lamps do not need additional electronic control gear or compensation capacitors (the CFLi lamp has an integrated control gear).

6. WEEE

All CFLi lamps with any base fulfil the demands of WEEE (Waste of Electrical and Electronic Equipment Directive 2002/96/EC) and have to be in consensus with National Laws in the European Union and to be marked accordingly.

7. Maximum Hazardous Substances Content (RoHs)

All CFLi Lamps have to fulfil the targets set by the EU Directive RoHs (2002/95/EC).

9. GLS Replacement Requirement by CFLi Lamps

CFLi lamps are intended to replace incandescent lamps, and have the equivalent claim requirement outlined in *Annex 5*. The basis of equivalence shall be to achieve the same amount of light output, expressed in lumens. For example: 11W CFLi = 60W GLS only when minimum 580 lumen is achieved.

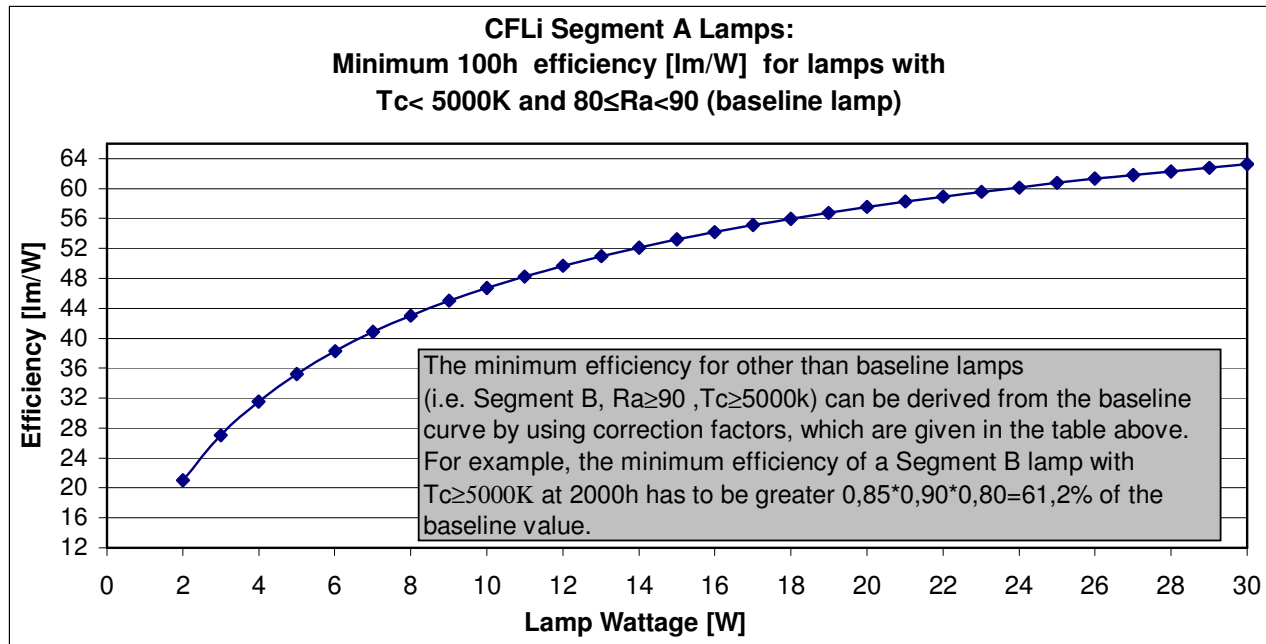
Addendum: This document is Best Available Technology (BAT) as of present day, 2007. Should new technologies introduced on the market, not be covered by *Annex 1* and *Annex 2*; this Eco-Profile should be updated.

Annex 1 – Compact Fluorescent Lamps with self-integrated ballast for general lighting applications

Segment	A				A				A				A			
	<5000K				≥5000K				<5000K				≥5000K			
Tc[K]	0,80≤Ra<90				0,80≤Ra<90				Ra≥90				Ra≥90			
	Ra		Ra		Ra		Ra		Ra		Ra		Ra		Ra	
P[W]	Light Output [lm]		Efficiency [lm/W]		Light Output [lm]		Efficiency [lm/W]		Light Output [lm]		Efficiency [lm/W]		Light Output [lm]		Efficiency [lm/W]	
	100h	2000h	100h	2000h	100h	2000h	100h	2000h	100h	2000h	100h	2000h	100h	2000h	100h	2000h
2.0	42	36	21.0	17.9	38	32	18.9	16.1	36	30	17.9	15.2	32	27	16.1	13.7
3.0	81	69	27.0	23.0	73	62	24.3	20.7	69	59	23.0	19.5	62	53	20.7	17.6
4.0	126	107	31.6	26.8	113	96	28.4	24.1	107	91	26.8	22.8	96	82	24.1	20.5
5.0	176	150	35.2	29.9	158	135	31.7	26.9	150	127	29.9	25.4	135	114	26.9	22.9
6.0	230	196	38.3	32.5	207	176	34.4	29.3	196	166	32.5	27.7	176	150	29.3	24.9
7.0	286	243	40.8	34.7	257	219	36.7	31.2	243	207	34.7	29.5	219	186	31.2	26.6
8.0	344	292	43.0	36.6	310	263	38.7	32.9	292	249	36.6	31.1	263	224	32.9	28.0
9.0	405	344	45.0	38.2	365	310	40.5	34.4	344	293	38.2	32.5	310	263	34.4	29.3
10.0	467	397	46.7	39.7	420	357	42.0	35.7	397	337	39.7	33.8	357	304	35.7	30.4
11.0	531	451	48.3	41.0	478	406	43.4	36.9	451	384	41.0	34.9	406	345	36.9	31.4
12.0	596	507	49.7	42.2	536	456	44.7	38.0	507	431	42.2	35.9	456	388	38.0	32.3
13.0	663	564	51.0	43.3	597	507	45.9	39.0	564	479	43.3	36.8	507	431	39.0	33.1
14.0	730	621	52.1	44.3	657	558	46.9	39.9	621	527	44.3	37.7	558	475	39.9	33.9
15.0	798	678	53.2	45.2	718	610	47.9	40.7	678	577	45.2	38.4	610	519	40.7	34.6
16.0	867	737	54.2	46.1	780	663	48.8	41.5	737	626	46.1	39.2	663	564	41.5	35.2
17.0	937	796	55.1	46.9	843	717	49.6	42.2	796	677	46.9	39.8	717	609	42.2	35.8
18.0	1008	857	56.0	47.6	907	771	50.4	42.8	857	728	47.6	40.5	771	655	42.8	36.4
19.0	1079	917	56.8	48.3	971	825	51.1	43.5	917	780	48.3	41.0	825	702	43.5	36.9
20.0	1151	978	57.6	48.9	1036	881	51.8	44.0	978	832	48.9	41.6	881	748	44.0	37.4
21.0	1224	1040	58.3	49.5	1102	936	52.4	44.6	1040	884	49.5	42.1	936	796	44.6	37.9
22.0	1297	1102	58.9	50.1	1167	992	53.1	45.1	1102	937	50.1	42.6	992	843	45.1	38.3
23.0	1371	1165	59.6	50.7	1234	1049	53.6	45.6	1165	991	50.7	43.1	1049	891	45.6	38.7
24.0	1444	1227	60.2	51.1	1300	1105	54.2	46.0	1227	1043	51.1	43.5	1105	939	46.0	39.1
25.0	1520	1292	60.8	51.7	1368	1163	54.7	46.5	1292	1098	51.7	43.9	1163	988	46.5	39.5
26.0	1595	1356	61.3	52.1	1436	1220	55.2	46.9	1356	1152	52.1	44.3	1220	1037	46.9	39.9
27.0	1670	1420	61.9	52.6	1503	1278	55.7	47.3	1420	1207	52.6	44.7	1278	1086	47.3	40.2
28.0	1745	1483	62.3	53.0	1571	1335	56.1	47.7	1483	1261	53.0	45.0	1335	1135	47.7	40.5
29.0	1821	1548	62.8	53.4	1639	1393	56.5	48.0	1548	1316	53.4	45.4	1393	1184	48.0	40.8
30.0	1897	1612	63.2	53.7	1707	1451	56.9	48.4	1612	1371	53.7	45.7	1451	1234	48.4	41.1

B				B				B				B			
<5000K				≥5000K				<5000K				≥5000K			
0,80≤Ra<90				0,80≤Ra<90				Ra≥90				Ra≥90			
Light Output		Efficiency		Light Output		Efficiency		Light Output		Efficiency		Light Output		Efficiency	
100h	2000h	100h	2000h	100h	2000h	100h	2000h	100h	2000h	100h	2000h	100h	2000h	100h	2000h
36	29	17.9	14.3	32	26	16.1	12.9	29	23	14.3	11.4	26	21	12.9	10.3
69	55	23.0	18.4	62	50	20.7	16.5	55	44	18.4	14.7	50	40	16.5	13.2
107	86	26.8	21.5	96	77	24.1	19.3	86	69	21.5	17.2	77	62	19.3	15.5
150	120	29.9	24.0	135	108	26.9	21.6	120	96	24.0	19.2	108	86	21.6	17.2
196	156	32.5	26.0	176	141	29.3	23.4	156	125	26.0	20.8	141	113	23.4	18.7
243	194	34.7	27.8	219	175	31.2	25.0	194	156	27.8	22.2	175	140	25.0	20.0
292	234	36.6	29.3	263	211	32.9	26.3	234	187	29.3	23.4	211	168	26.3	21.1
344	275	38.2	30.6	310	248	34.4	27.5	275	220	30.6	24.5	248	198	27.5	22.0
397	318	39.7	31.8	357	286	35.7	28.6	318	254	31.8	25.4	286	229	28.6	22.9
451	361	41.0	32.8	406	325	36.9	29.5	361	289	32.8	26.3	325	260	29.5	23.6
507	405	42.2	33.8	456	365	38.0	30.4	405	324	33.8	27.0	365	292	30.4	24.3
564	451	43.3	34.7	507	406	39.0	31.2	451	361	34.7	27.7	406	325	31.2	25.0
621	496	44.3	35.4	558	447	39.9	31.9	496	397	35.4	28.4	447	357	31.9	25.5
678	543	45.2	36.2	610	488	40.7	32.6	543	434	36.2	28.9	488	391	32.6	26.0
737	590	46.1	36.9	663	531	41.5	33.2	590	472	36.9	29.5	531	424	33.2	26.5
796	637	46.9	37.5	717	573	42.2	33.7	637	510	37.5	30.0	573	459	33.7	27.0
857	685	47.6	38.1	771	617	42.8	34.3	685	548	38.1	30.5	617	494	34.3	27.4
917	734	48.3	38.6	825	660	43.5	34.8	734	587	38.6	30.9	660	528	34.8	27.8
978	783	48.9	39.1	881	704	44.0	35.2	783	626	39.1	31.3	704	564	35.2	28.2
1040	832	49.5	39.6	936	749	44.6	35.7	832	666	39.6	31.7	749	599	35.7	28.5
1102	882	50.1	40.1	992	794	45.1	36.1	882	706	40.1	32.1	794	635	36.1	28.9
1165	932	50.7	40.5	1049	839	45.6	36.5	932	746	40.5	32.4	839	671	36.5	29.2
1227	982	51.1	40.9	1105	884	46.0	36.8	982	786	40.9	32.7	884	707	36.8	29.5
1292	1034	51.7	41.3	1163	930	46.5	37.2	1034	827	41.3	33.1	930	744	37.2	29.8
1356	1085	52.1	41.7	1220	976	46.9	37.5	1085	868	41.7	33.4	976	781	37.5	30.0
1420	1136	52.6	42.1	1278	1022	47.3	37.9	1136	908	42.1	33.6	1022	818	37.9	30.3
1483	1187	53.0	42.4	1335	1068	47.7	38.1	1187	949	42.4	33.9	1068	854	38.1	30.5
1548	1238	53.4	42.7	1393	1114	48.0	38.4	1238	991	42.7	34.2	1114	892	38.4	30.7
1612	1290	53.7	43.0	1451	1161	48.4	38.7	1290	1032	43.0	34.4	1161	929	38.7	31.0

Lamp properties	Segment	Correction factor in %	Lamp age	
			100h	2000h
Baseline (Tc<5000K and 0,8≤Ra<90)	A	100.0%	100.0%	85.0%
Tc≥5000K		90.0%	90.0%	76.5%
Ra≥90		85.0%	85.0%	72.3%
Tc≥5000K and Ra ≥ 90		76.5%	76.5%	65.0%
Lumen loss 100h -> 2000h		85.0%		
Baseline (Tc<5000K and 0,8≤Ra<90)	B	85.0%	85.0%	68.0%
Tc≥5000K		90.0%	76.5%	61.2%
Ra≥90		80.0%	68.0%	54.4%
Tc≥5000K and Ra ≥ 90		72.0%	61.2%	49.0%
Lumen loss 100h -> 2000h		80.0%		



The minimum efficiency for other than baseline lamps (i.e. Segment B, $R_a \geq 90$, $T_c \geq 5000\text{k}$) can be derived from the baseline curve by using correction factors, which are given in the table above. For example, the minimum efficiency of a Segment B lamp with $T_c \geq 5000\text{K}$ at 2000h has to be greater $0,85 * 0,90 * 0,80 = 61,2\%$ of the baseline value.

Segment A:

- The 100 hrs efficacy at $T_k > 5,000\text{K}$ shall be ≥ 0.90 of the $T_k \leq 5,000\text{K}$ value.
- The 100 hrs efficacy at $R_a \geq 90$ shall be ≥ 0.85 of the $80 \leq R_a < 90$
- The 100 hrs efficacy at $R_a \geq 90$ and $T_k \geq 5,000\text{K}$ shall be ≥ 0.765 of the $T_k < 5,000\text{K}$ and $80 \leq R_a < 90$.
- The efficacy maintenance at 2,000 hrs shall be ≥ 0.85 of the 100 hr efficacy value.

Segment B:

- The 100 hrs efficacy at $T_k > 5,000\text{K}$ shall be ≥ 0.90 of the $T_k \leq 5,000\text{K}$ value.
- The 100 hrs efficacy at $R_a \geq 90$ shall be ≥ 0.80 of the $80 \leq R_a < 90$
- The 100 hrs efficacy at $R_a \geq 90$ and $T_k \geq 5,000\text{K}$ shall be ≥ 0.72 of the $T_k < 5,000\text{K}$ and $80 \leq R_a < 90$.
- The efficacy maintenance at 2,000 hrs shall be ≥ 0.80 of the 100 hr efficacy value.

Annex 2 – Compact Fluorescent Reflector Lamps with self-integrated ballast for general lighting applications

Segment C:

Efficacy Measurement of Reflector Lamps

The proposal is a measure, where you first measure the peak beam intensity in candelas. Then calculate the beam angle at which it has fallen off to 50% intensity (the edge of the useful beam of light coming from the lamp. Beyond this level it's really only stray light that's not going anywhere useful in the beam. This action would first equalise the efficacy of all reflector lamps, whether they be spot or flood types, on the same scale to allow direct comparisons to be made.

Finally you would then measure what is the total lumens contained within this cone of useful light varying from 100% down to 50% intensity. And then rate this according to the lamp wattage, to take account of the individual burner efficacies, use of improved gases, IRC coatings etc. With the final figure you could then construct the usual scale eg. from A to F. It would be sensible to rate this information on 1000-hour data, so that it also takes into account the poor through-life performance of many bad lamps which quickly go black, and suffer rapid lumen depreciation.

CFLi reflector lamps are not intended to replace tungsten halogen or incandescent reflector lamps.

The measurement of reflector lamps is outlined in IEC/EN 61341.

The only fair comparison for CFLi reflector lamps when compared to any halogen and GLS lamps, shall be based on candelas. But this comparison is difficult due to the size of the CFLi reflector lamp discharge tube and the filament in a GLS lamp and/or halogen lamp. The CFLi reflector brightness (candelas) is less than the expected amount of GLS/halogen brightness (candelas). Therefore, CFLi reflector lamps shall be used only where wide beam angles ($> 60^\circ$) are needed.

This Eco-Profile will not address specialty reflector lamps.

Annex 3: *Lamps not used for general lighting but for special applications and thus excluded from performance criteria specified in Annex 1 and Annex 2:*

- Coloured lamps
- Visible blue spectral lamps (e.g. range of 400-550nm)
- UV lamps
- Sun tanning lamps
- Disinfection lamps
- Medical/Therapy lamps
- Pet care lamps
- Lamps for food lighting, bakeries
- Induction lamps any shape
- Speciality Reflector lamps

Annex 4: *Testing requirements and conditions for the Minimum Performance Standards (based on standard EN 50285)*

1. Test conditions

Lamps shall be tested in accordance with the relevant clauses of the standards listed below.

- IEC/EN 60968: "Self-ballasted lamps for general lighting services - safety requirements"
- IEC/EN 60969: "Self-ballasted lamps for general lighting services - Performance requirements".
- IEC/EN 60061: "Lamp caps and holders together with gauges for the control of interchangeability"

2. Verification

The minimum sample size shall be twenty lamps per homogenous same type of lamp (for example - colour rendering and temperature, wattage, cap, shape and brand). The sample shall be representative of a manufacturer's production. This can be achieved by randomly selecting lamps from at least four different points of sale.

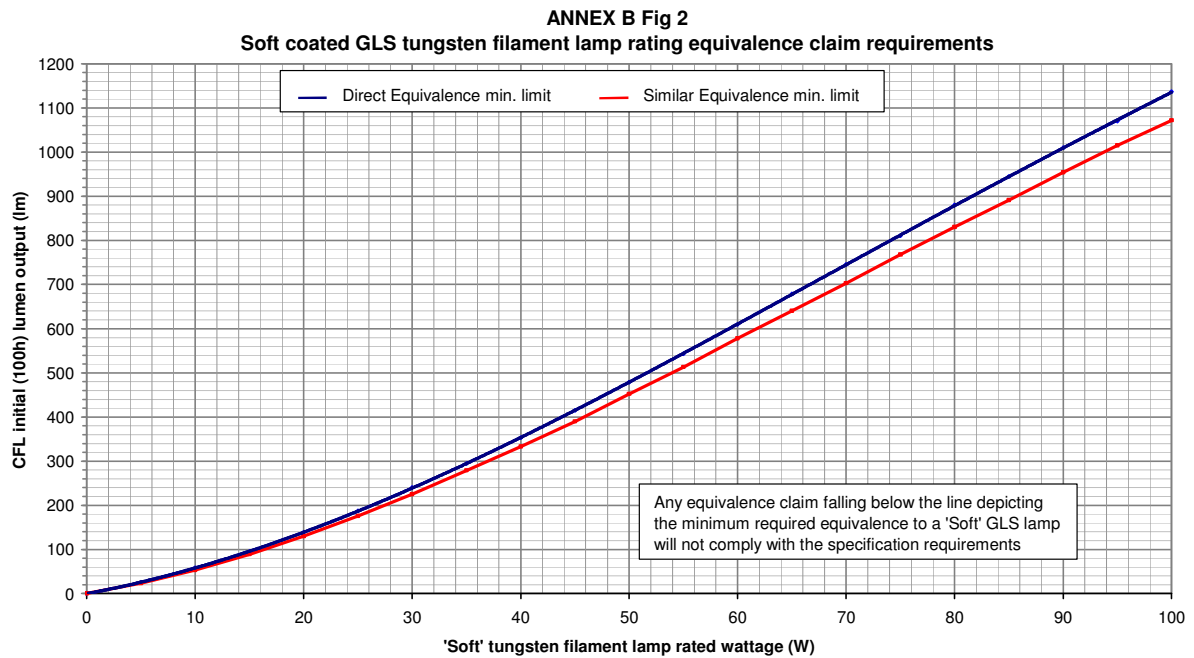
The results of the tests shall comply with requirements given in *Annex 1*. If the results do not comply with these requirements, manufacturer's test records shall be requested.

Annex 5: GLS Replacement Requirement by CFLi Lamps

The following chart identifies the CFLi lamp equivalent of a GLS lamp, with the following minimum lumen performance criteria.

GLS (W) Equivalent	CFLi Lumen
25	185
40	330
60	580
75	760
100	1080

Please note: This data is based on double coil incandescent lamps and compares like for like lamps (frosted GLS lamps with CFLi).



Source: Energy Saving Trust – Lamp Specification – Version 6