
PHILIPS
LED Luminaires
White paper
Evaluating
performance of
LED based
luminaires

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Both 'initial' and 'over time' performance have to be evaluated in order to have confidence how LED based luminaires will perform and how long they will sustain their rated characteristics over their years of operation.

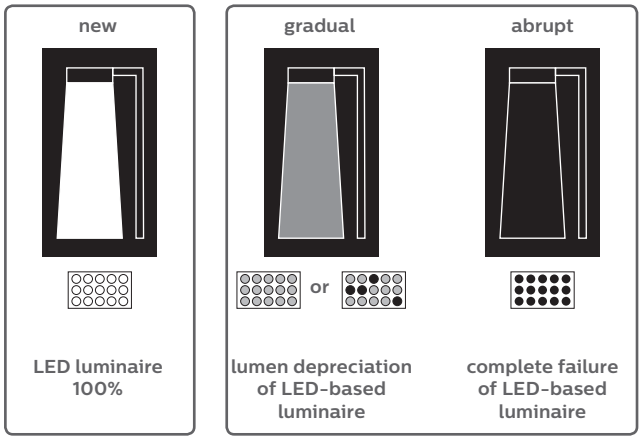


Figure 1 – Over time performance

Gradual light output degradation relates to the lumen maintenance of a luminaire over time. It tells you how much of the initial lumen output of the luminaire is maintained after a certain period of time. The lumen depreciation can be a combination of degradation of optical elements used, individual LEDs giving less light and individual LEDs giving no light at all.

Abrupt light output degradation describes the situation where the LED based luminaire no longer gives any light at all because the system, or a critical component therein, has failed.

The IEC lifetime metric for LED based luminaires specifies Useful Life and Time to Abrupt Failure.

1. Gradual light output degradation / Useful Life

A gradual lowering of the light output and loss of efficiency

The gradual light output degradation of a population of LED based lighting products at a certain point in time is called Useful Life and is generally expressed as L_xB_y. Useful Life describes the lumen maintenance of a LED based luminaire over time.

Useful Life is expressed as L_xB_y and means length of time during which y% of a population of operating LED based luminaires of the same type fail to provide at least x% of the initial luminous flux. 'L_x' describes the lumen maintenance: L_{80} means that the luminaires of this specific type still give 80% of their initial light output.

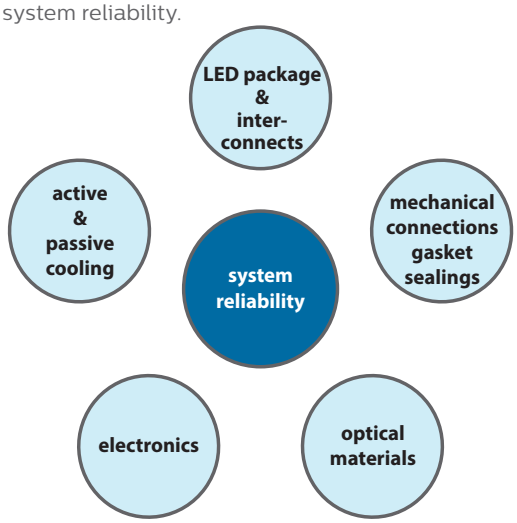
'B_y' describes for what percentage of the population that is true. The example $L_{80}B_{50}$ reflects the age (in hours) at which 50% of the population have failed parametrically. Parametrically in this case means a LED based luminaire producing less light than 80% of its initial flux but still operating.

2. Abrupt light output degradation / Time to Abrupt Failure

An abrupt decline in light output due to breakdown or failure of the product or any of the components in the system

Besides lumen maintenance (Useful Life), there are other factors to consider when evaluating performance over life.

LED based luminaires and modules are sophisticated products consisting of many components. An important parameter that should be considered with expected long life is system reliability. A LED based luminaire will last as long as the component used with the shortest life. There are several critical components of a LED based luminaire that influence the system reliability.



The IEC lifetime metric therefore also specifies time to abrupt failure, which takes into account failure modes of critical components in the LED based luminaire design.

The abrupt light output degradation of a population of LED based lighting products at a certain point in time is called Time to Abrupt Failure and is expressed as L_0C_y. Time to Abrupt Failure describes the situation where the LED based luminaire no longer gives any light at all. 'Lx' describes the lumen maintenance: L_0 means that the LED based luminaires of this certain type give 0% of their initial light output. 'C_y' describes for what percentage of the population that is true. The example L_0C_{10} reflects the age (in hours) at which 10% of the population have failed abruptly.

Unfortunately, the industry has not yet reached consensus on what critical components have to be taken into account when calculating Time to Abrupt Failure. Therefore, Philips Lighting has decided not to publish this value as long as there is a risk of apple-to-pear comparison.

What Philips Lighting publishes on 'initial' performance

To benefit from our standard development work in the IEC, initial performance specifications for all Philips Professional Lighting Solutions Europe LED based (general) lighting luminaires are measured in compliance with the appropriate performance standards.

1. Initial rated input power (in W)
2. Initial rated luminous flux (in lm)
3. Initial LED luminaire efficacy (in lm/W)
4. Luminous intensity distribution
5. Initial Correlated Color Temperature (CCT) in K
6. Initial rated Color Rendering Index (CRI)
7. Initial rated chromaticity co-ordinate value and expected tolerance (x,y) < x SDCM

Initial specifications of all LED based luminaires are specified at an ambient temperature of 25°C.

What Philips Lighting publishes on performance over time

The 'over time' performance specifications of Philips LED based luminaires are calculated using the IEC lifetime metric for LED based lighting products.

For **indoor** LED based luminaires Philips Lighting will publish two IEC-compliant quality criteria:
1. number of hours that correspond to the Median Useful Life values $L_{90}B_{50}$, $L_{80}B_{50}$ and $L_{70}B_{50}$;
2. the driver failure rate* at 5000 hours.

For **outdoor** LED based luminaires Philips Lighting will publish two IEC-compliant quality criteria:
1. number of hours that correspond to the Useful Life value $L_{80}B_{10}$;
2. the driver failure* rate at 5000 hours.

Over time life claims are specified at an ambient temperature of 25ºC with 12 burning hours per day and a number of switches in line with the main application.

For specific projects, tailor-made L_xB_y and L_0C_y calculations are available upon request

* NOTE: As soon as there is industry consensus on what failure modes of critical components to include in the calculations, Philips Lighting will publish the Abrupt Failure Value belonging to the number of hours specified for the (Median) Useful Life values mentioned above.

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