3F LED Technology

The real revolution is simplicity.

The LED is one of the most extraordinary inventions of recent times, and not just in the lighting sector.
If you needed any evidence that interest in this technology is huge, just try searching for “LED” in Google – you will get nearly half a billion hits! Unfortunately, there is an equal amount of confusion surrounding the topic.

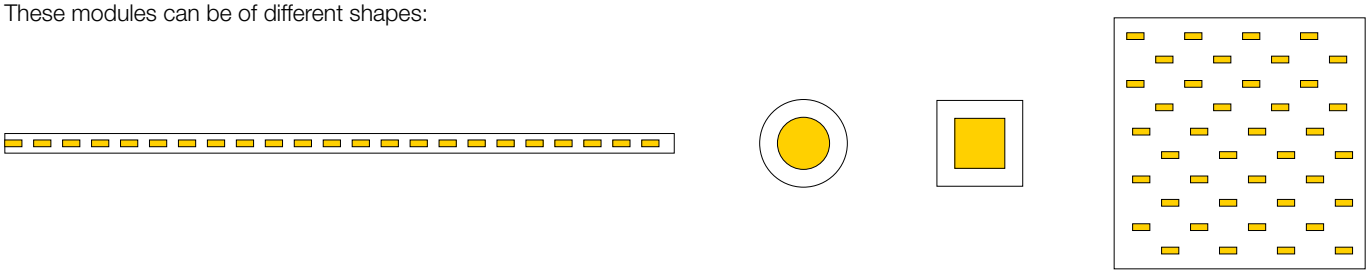
3F Filippi has put more than 60 years of experience in the field to work alongside its designers to create its new LED product line.
And the difference is plain to see: in a market for efficient light sources which is evolving and developing from one day to the next, 3F Filippi has decided to equip its luminaires with sources manufactured using the highest quality components available.

Unfortunately, one of the most common problems for lighting designers is the **lack of a common standard** to set how lighting companies declare the performance of these products: these "tricks" hinder comprehension and the ability to compare products.
For this reason, we have decided to shed light on the matter with this guide, by explaining LEDs and their most important Characteristics simply yet exhaustively.
Another step taken by 3F Filippi in this direction is the voluntary certification of our product data by compliance with the **Assil Quality** project (see page 400 for more information).

What is an LED?

LEDs are electronic components which emit light when an electrical current passes through them – the name, indeed, is an acronym for Light Emitting Diode. This is possible thanks to the optical properties of some semiconductors which emit photons when current is passed through them.

When a group of LEDs are installed on a printed circuit, this is known as an LED module.
These modules can be of different shapes:



linear circular compact squared

What are the advantages of 3F LED technology?

Illuminotechnical

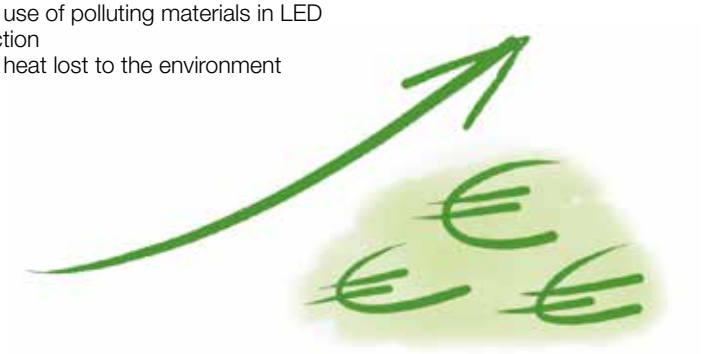
- High LED luminous efficiency, up to 155 lm/W
- Immediate switch-on
- Control of the luminous flux, directed light
- Absence of IR and UV components throughout the entire spectrum
- Very long lifetime, > 50,000 hours
- Lower power than traditional light sources
- Increased light
- Adjustment of luminous flux from as low as 1%

Environmental

- No mercury
- Lower CO_2 emissions thanks to lower power
- Less use of polluting materials in LED production
- Less heat lost to the environment

For the customer

- Reduction of energy costs
- Reduction of maintenance costs
- Fast return on investment



	Total luminaire power	Total energy consumption	Annual saving
2x58W fluorescent Wiring low-loss EEI=B2	141W	102 €	0%
2x58W fluorescent Wiring electronic EEI=A2	109W	78 €	- 24%
2x30W LED wiring electronic	68W	49 €	- 52%
2x24W LED wiring electronic	56W	40 €	- 61%

Table supposes electricity cost of €0.18 per kWh and total annual operation of 4,000 hours.

Is 3F LED technology safe?

Among 3F Filippi's top priorities is the well-being of those who are illuminated by our products. for this reason, we pay a great deal of attention to photobiological safety, using sources with a low impact on human health.

Unfortunately, some less scrupulous manufacturers use low-quality sources that emit radiation which, with prolonged exposure, is damaging to organs of the human housing, such as the eyes and skin. The quantities of radiation emitted by all sources in the range of wavelengths from 200 nm to 3000 nm.

For this reason, **Photobiological Safety Risk Groups** have been defined in order to provide clear indications in this regard.
The risk groups are defined on the basis of exposure time, with exposure limits determined from these (IEC 62471).

RG 0 (Risk absent group) – Absence of danger
The limits are calculated with very long exposure times; it follows that the levels specified for this group are never able to cause danger even following prolonged exposure.
RG 1 (Low risk group) – Absence of risk thanks to the product's intrinsically limited emission of radiation. The limits are calculated with lower exposure times which guarantee safe exposure thanks to the natural limitations of exposure thanks to normal use of the product.
RG 2 (Medium risk group) – Danger due mainly to photochemical and thermal effects. The source does not cause a risk thanks to an instinctive, spontaneous reaction in those looking at very bright light sources or a sensation of thermal discomfort.
RG 3 (High risk group) – Danger present also in cases of brief, limited exposure. The source can constitute a risk even thanks to momentary or brief exposure.

European legislation states that companies, specifically the statutory employer, evaluate and manage risks to workers' health and safety. Among the risks that the employer must evaluate is any photobiological risk deriving from exposure to artificial optical radiation. The reference standard is IEC/EN 62471: 2010, which does not define a threshold marking safe from unsafe, but rather defines classification of sources into risk groups.
Limitations of use or warnings for the user are contained in the corresponding product standards, while a product marking guide is contained in IEC TR 62471-2: 2009.

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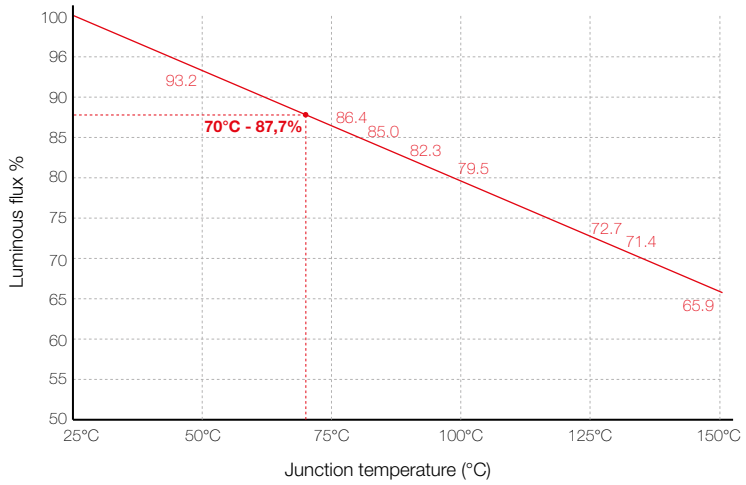
What are the aspects to consider when choosing an LED luminaire?

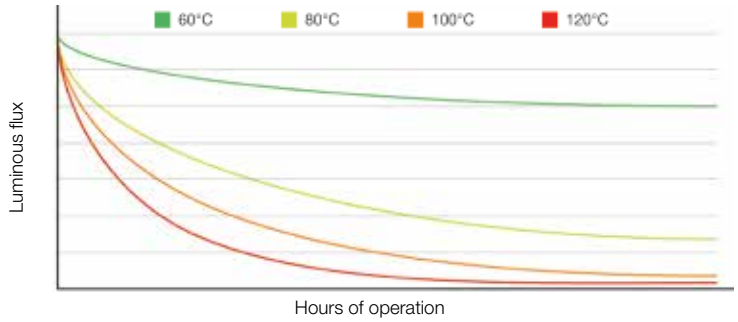
Suitable functioning-temperature

In order for LED modules to be able to function correctly and ensure a long lifetime (>50,000 h), a limited drop in luminous flux over time (>L85) and high luminous efficiency (>140 lm/W), they must be able to correctly dissipate the heat they generate.
The rated data for LEDs applies only if the junction temperature (Tj) is not exceeded. for this reason, 3F Filippi performs a series of thermal and illuminotechnical tests on our LED luminaires which allow us to achieve the best combination of heat dissipation, luminous flux and rated power.



Luminous flux and Junction temperature Tj

The junction temperature Tj is the internal temperature of the LED.
As the graph on the left shows, **the luminous flux emitted by the LED is linked to the operating junction temperature (normally between 60°C and 80°C)** and falls very fast as Tj increases.
It is very important to note that **there are many manufacturers who declare luminous flux with a junction temperature of Tj 25°C.**
This is an incorrect specification, as it does not reflect the product's actual operating conditions. This is clear when you consider that standards require the measurements to be taken at an ambient temperature of 25°C – this would mean that the LED does not technically produce any heat, a physically impossible condition.
3F Filippi suggests you be wary of components which do not provide for correct heat dissipation and that you request data on life expectancy, lifetime and luminous flux from measurements on luminaires which are running and thermally stabilised.

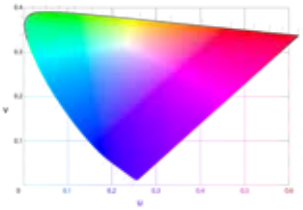


Thermal management

To maximise reliability of the performance of LED equipment, correct thermal dissipation is essential.
The temperature is fundamentally important as it influences the luminosity and lifetime of the LED component.
3F Filippi pays great attention to this factor and as a result we develop luminaires which ensure optimum heat dissipation.
The graph on the left shows the relationship between luminous flux and junction temperature Tj (functioning-temperature).

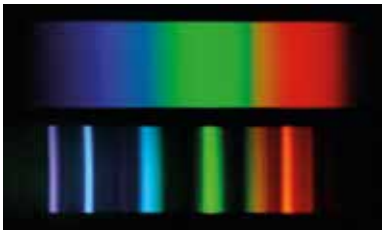
Colour rendering (Ra)

The colour rendering index is an important parameter for the performance of a light source, and evaluates the source's ability to provide an accurate perception of an object's real colours.
All LEDs used by 3F Filippi have colour rendering Ra>80, with a typical average value of around 85.
Where not already provided for, high colour rendering of Ra>90 can be requested on some products.



Colorimetry and light spectrum

LED sources have a light spectrum with greater uniformity across the whole range of colours.
Unlike traditional light sources, LEDs do not have interruptions in colour, thus guaranteeing complete vision of the entire range of colours – just like natural light.



Typical LED light spectrum

Typical light spectrum for traditional sources

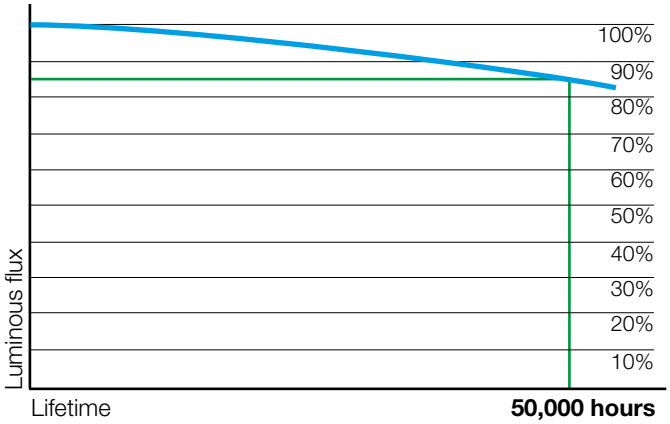
3F LED technology: Glossary

Luminous flux
The luminous flux, or luminous flux, coming from the luminaire represents the quantity of light actually coming out of the luminaire, with the luminous efficiency having already been considered.

Luminous efficiency
The luminous efficiency of the luminaire is the most useful parameter for the designer for determining the correct luminaires to install as it supplies a practical figure between light emitted and total power consumption of the light.
Beware of publications listing higher luminous efficiencies based on the theoretical efficiency of the bare LED (reference temperature 25°C) and not its actual performance when installed inside the luminaire.

Relative humidity
For correct maintenance and operation of traditional LED modules over time, the maximum permissible humidity on the component is 85%.
For specific applications, UR95 LED modules may be required, guaranteeing correct operation at humidity values of up to 95%.

Lifetime (L value)
As previously mentioned, LED sources, unlike traditional lighting, do not tend to suddenly blow at the end of their lifetime;
LEDs rather have a gradual reduction of their luminous output overtime before completely running out after a very long time.
The decay percentage of the luminous flux with reference to the useful number of operating hours (usually 50,000 hours) is therefore determined with the parameter “L”.
L85: 50000h therefore means that, having reached 50,000 h of operation, the LED module still provides 85% of its initial luminous flux.
We should clarify that this parameter is strongly influenced by the operating conditions of the LED inside the luminaire, and the result is therefore a combination of the quality of the component and good research.



LED life expectancy (B value)
In LED ratings the value B, followed by a value normally between 10 and 50, indicates the quality of the component used as it defines the percentage of components which, after the normal 50,000 h have elapsed, do not maintain their rated luminous flux.
An LED with declared values of L85/B10=50,000h indicates that on reaching 50,000h, 90% (B10) of the components will have a residual luminous flux of at least 85% of the initial value (L85).
If the B value is not indicated in the specifications of an LED luminaire, this should be considered to be B50.
We should clarify that this parameter is strongly influenced by the operating conditions of the LED inside the luminaire, and the result is therefore a combination of the quality of the component and good research.

LED failure rate (C value)
This value indicates the percentage of LEDs which are no longer operational at the end of their lifetime.
This value can be indicated with two combinations:
- L85/B10/C0: 50,000 hours - indicates that after 50,000 hours, the percentage of LEDs no longer working is 0%.
- L85/B10: 50,000 hours - L0/C5: 150,000 hours - indicates that after 150,000 hours, the percentage of LEDs no longer working is 5%.

All LEDs used by 3F Filippi have a failure rate C0 after 50,000 hours. If this value is not indicated, it should be considered to be C0.

Imperfection rate (F value)
On the basis of new requirements for LED modules, the f value, followed by a value normally between 10 and 50, provides a more detailed indication of the quality of the component used as it defines, as well as the percentage of components which do NOT maintain their declared luminous flux Characteristics (B), also the failure percentage of the LED component.
Imperfection rate “F” = “B” value + “C” value
On 3F LEDs, as the “C” value is 0, the imperfection rate “F” is the same as the life expectancy (“B” value).

Colour tolerance (MacAdam ellipses)
Measurement of the chromatic co-ordinates performed during production of the LED allows selection (known as Binning) to classify the LEDs on the basis of their chromatic differences.
This classification, performed via analysis of the so-called MacAdam ellipses (which express colour deviations on the XY axes), allows constant tonality to be obtained among the individual LEDs in the same group and therefore a uniform vision of the light colouration visible on the product.
- With the value 1 there is no chromatic difference between the individual LEDs;
- With values 2 and 3 the difference is not visible to the human eye and the LEDs are considered of good quality;
- With a value of 4, the difference begins to become visible to the human eye;
- As the value increases, the difference is increasingly noticeable, and the type of application will dictate whether these differences in colouration in the LED group used are acceptable or not.