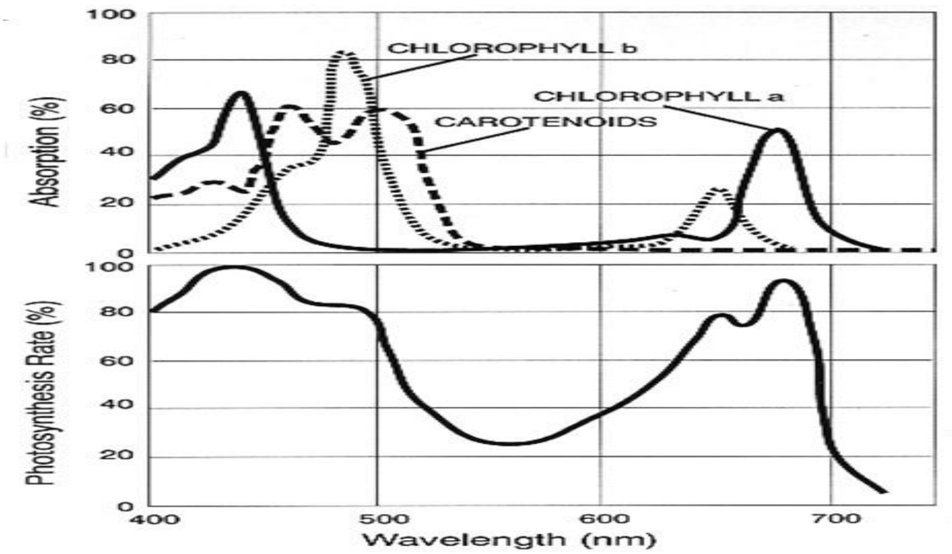
Agro 850/930 Illuminators by Spectro Light

Advantage owing to the best technologies combined

Agro 850 and **Agro 930 illuminators** are the most technically advanced series of our products intended for professionals. They were built based on the best technologies.

Before to proceed to describing our design, I will make an attempt to present and discuss the best assimilation illuminators on the example of illuminators manufactured by Philips and Osram.

The best spectrum and, at the same time the most universal one is:



Based on a photosynthetically active spectrum, we can differentiate three groups of bands:

I. **430-470nm – blue band.** It is in this range where the peak of light absorption for chlorophyll B and B-carotenes is found. This band stimulates the vegetative phase and strengthens pigmentation, as well as increases the content of terpenes.
II. **500-600nm – green filling band**, which has a positive effect on metabolism. To a considerable extent, it improves efficiency of other bands. As a result of the conducted studies on the role of 'green light' we know it is a fully absorbed energy, mainly in the lower part of the leaf.
III. **640-680nm – red band**, in fact 660nm, is the strongest active part of the spectrum for plants that regulates the generative stage, the flowering stage and other processes, that is, induction of flowering and bud formation.

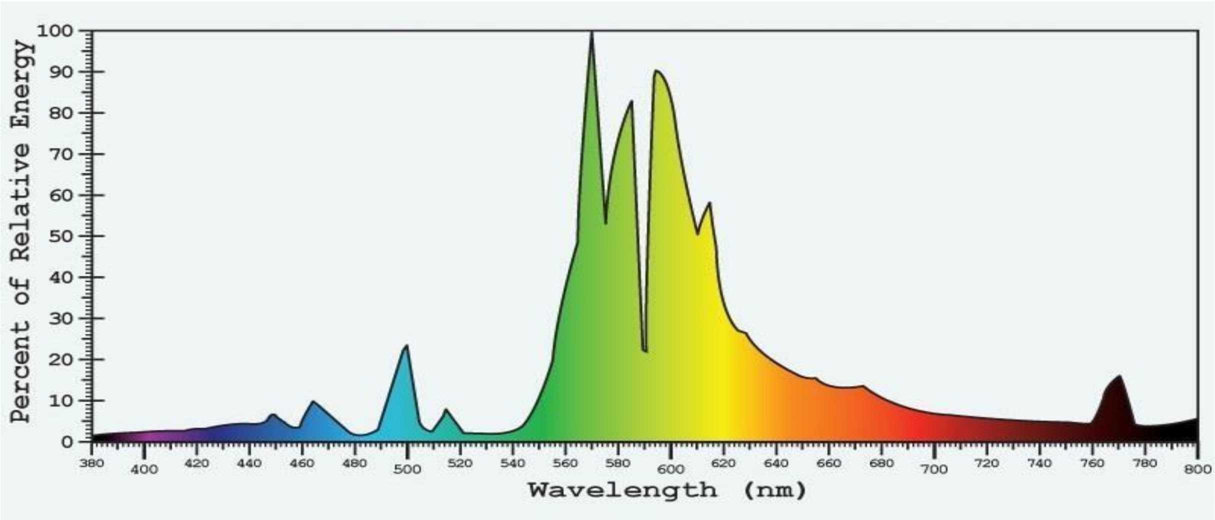
And what about the optimum proportions for the generative and the flowering phases?

I. 430-470nm - 10-15% share
II. 500-600nm - 20-25% share

III. 640-680nm - 60-70% share

Although the 500-600nm green band can be omitted due to the fact that in greenhouse conditions it is provided by the sun, its amount is considerably reduced in Polish geographical conditions during the autumn-winter period. Studies[i] on this part of emission indicate that this spectrum is almost fully absorbed by the plant and, additionally, even its excessive amount will not be wasted but contribute to improved pace of metabolism and serves a regulatory function in many photosynthesis processes.

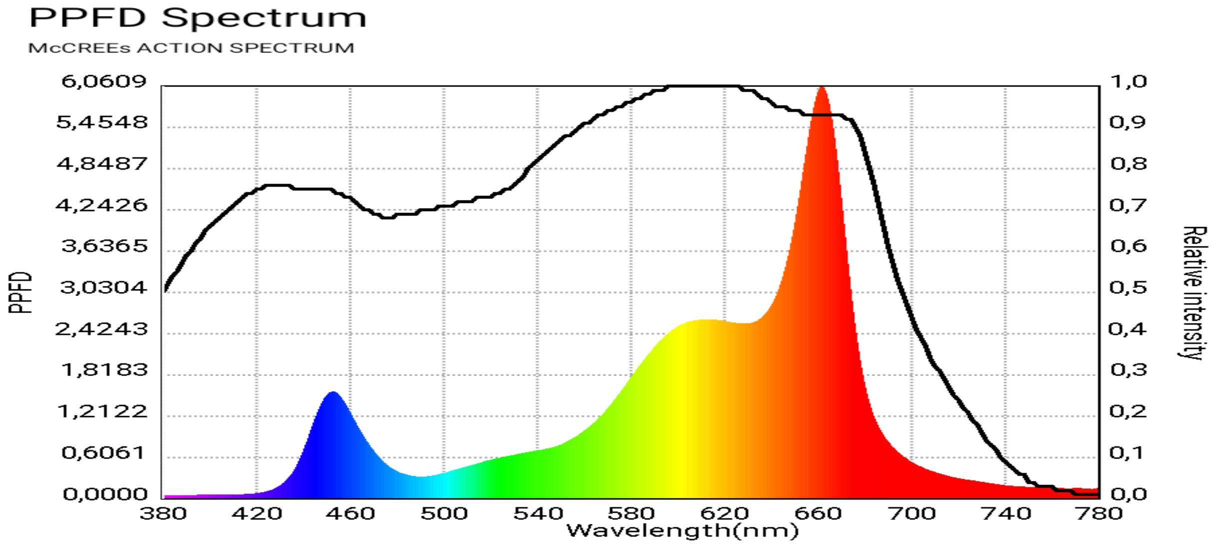
Sodium lamp spectrum:



The fact that the spectrum of a sodium lamp is 45% of the band is 500-600nm and the remaining part is 600-700nm falls onto the range of 640nm alone is enough, as this could be translated into a very low photosynthetic efficiency. **Nothing could be further from the truth!** Studies prove that the emission is efficient throughout the range of photosynthetic activity, and the broader the emission (the more wavelengths is covers instead of specific ones), the more beneficial effect it has on photosynthetic processes.

I would like to note that if the 500-600nm range was inefficient, LED illuminators would prove somewhat a perpetuum mobile, as they would gain more Energy than the amount emitted. That is, of course, not the case, and physics relentlessly verifies inclinations of marketing activities of numerous LED lighting manufacturers.

The above information gives us the following model of a universal assimilation illuminator



Where the share of individual bands is as follows:

- 430-480nm - 11%
- 500-550nm* - 8%
- 550-600nm - 15%
- 600-700nm - 61%
- 700-750nm - 4%

*The share of the **500-550nm** band ensures a very high coefficient of rendering **84Ra** colours, which is very significant for the **proper assessment** of plant quality and selection at harvest.

The technology and its efficiency.

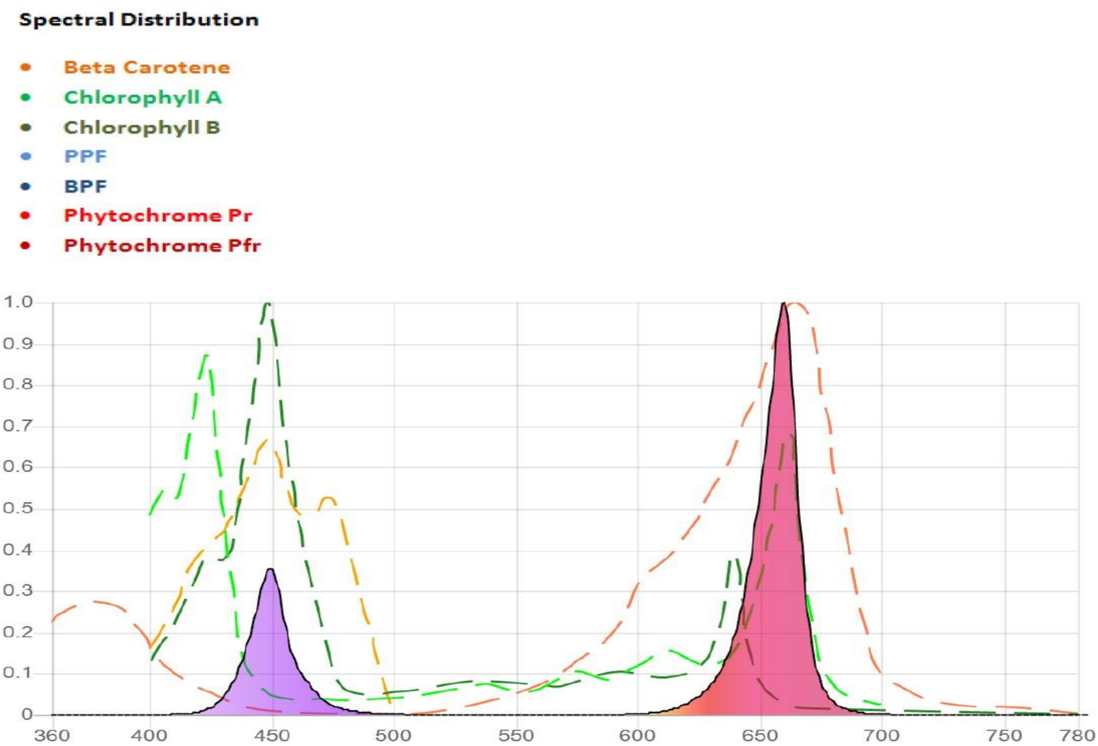
In our model illuminator, we used 2 best types of LED:

I. **LEDs based on a blue diode,** which are perfect for the range of 430 – 600nm. The emission of over 600nm is by far less effective than when using a red LED. Due to a higher operating voltage (~3V) instead of ~2V, as in the case of a red diode, they reach efficiency of **2.3-2.6µmol/J.**

II. **Leds based on a red diode,** which are perfect as a complement of the spectrum generated on the basis of a blue diode and owing to their main emission band of 620-680nm and the operating voltage of 2V, they have a decisive impact on the general efficiency of the LED luminaire. The red diode reaches efficiency at **3.2-3.7µmol/s.**

In what ways is our luminaire different to the competition's luminaires?

Let us pass over luminaires of only blue and red colour, based on monochrome LEDS of a spectrum similar to the one below,

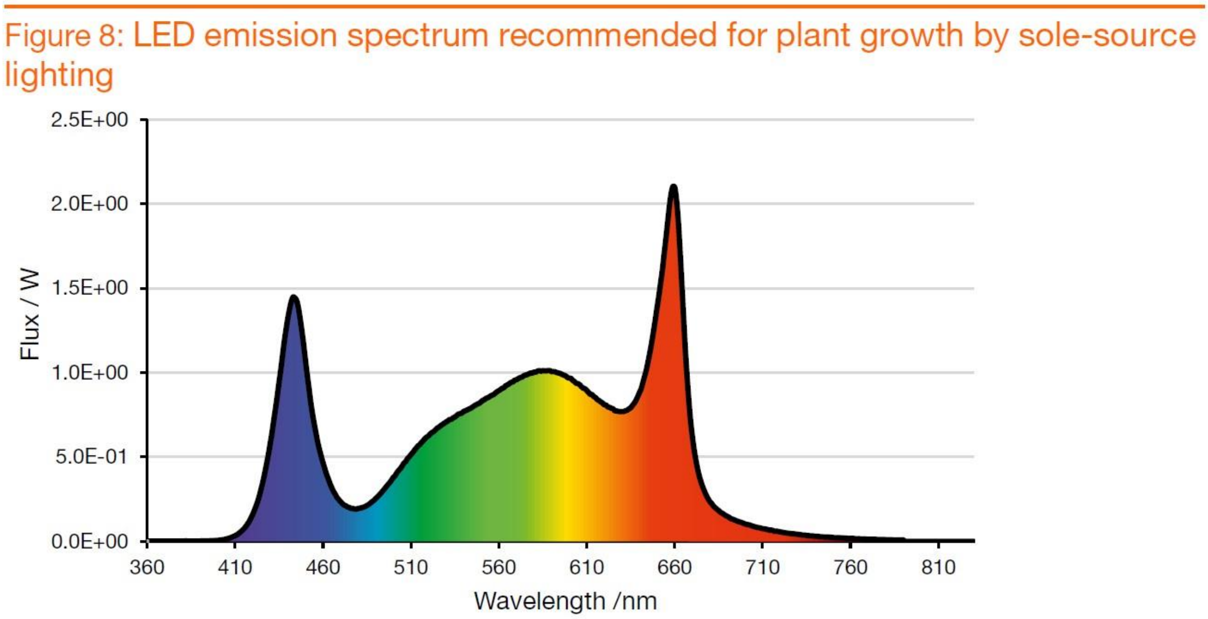


As they do not ensure the spectrum range of 550-630nm and 680-700nm, and due to the lack of the 500-550nm wavelength, the way colours are rendered and the way a human eye perceives them, they cannot be accepted and even harmful for human according to PN-EN 62471:2010[ii]. These luminaries are supported by the fact that it can ensure the efficiency of 2.55µmol/J.

According to our studies conducted at INHORT Skierniewice Institute, this efficiency in the short-day period of low sunlight intensity, particularly in autumn and winter months, may decrease efficiency of such assimilation lighting down to 20%. This is a direct effect of the absence of the sufficient emission at 500-600nm.

This case can be solved by combining such an illuminator with a traditional sodium illuminator (1.67µmol/J) at a ratio of 50/50%, yet this will compromise the resulting efficiency of such a set to **2.01µmol/J.**

The competition's solution consisting in combining 3 LED diodes together (below),



Source: www.osram-os.com LEDs for horticultural lighting applications.

based on a 450nm blue diode, a 4000K white diode and a 660nm red diode, has 2 basic disadvantages:

1. White LEDs do not generate efficiency at the level as high as clear blue LEDs and reach only to 2,02,3µmol/J. This is due to the necessity to use phosphorus to change the wavelength of the blue light of 450nm to the spectrum of 500-600nm, and such a transformation takes place at the price of 10-15% efficiency.
2. The spectrum of the white diode is designed for the human eye and not for plants and its main part falls onto the band of 500-550nm, and additionally leaves a large gap in the band of high photosynthetic activity, 600-640nm.

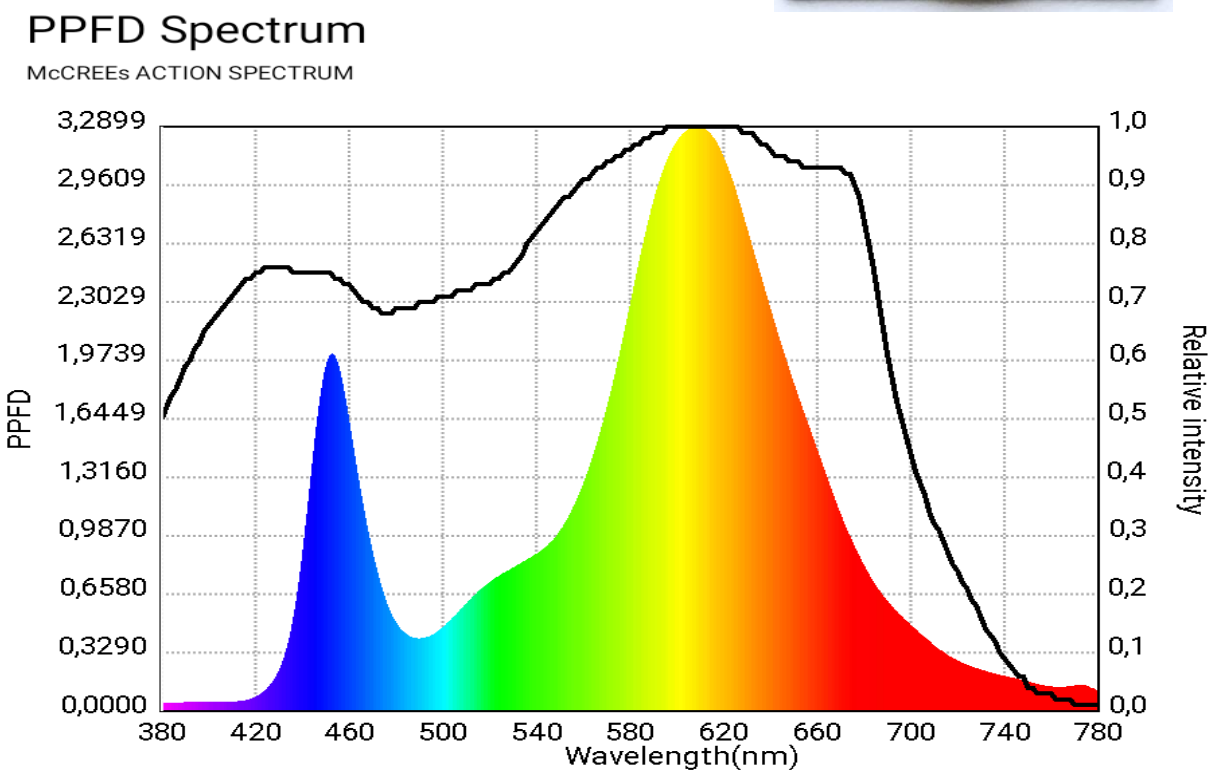
This allows such an illuminator based on these 3 LED to reach not more than **2.1-2.35µmol/J.**
Moreover, it should be noted that losses due to PMMA acrylic optics ensure decreased efficiency of such a luminaire within 2-3 years down to 5-6%. This results from the property and low mechanical durability of the material used for making the lenses.

Another thing that should be critically assessed are power systems with a short lifespan up to 5-7 years, which is due to the use of low-quality condenser and their application in difficult greenhouse conditions. Their passive body creates a large shading surface that limits sunlight passing through when its most active.

Let's talk about us and our latest Agro 850W Illuminator.

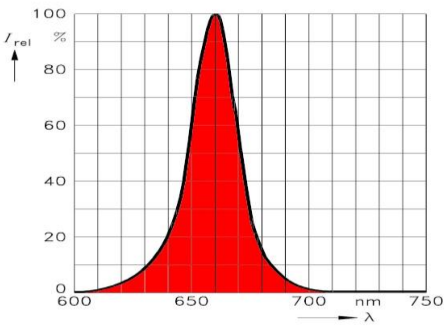
In our solution, we combined the blue diode and the red diode technologies:

COB-type LED (Chip On Board) – we based them on the most effcient blue crystals by Sannan, effectiveness at **2.65µmol/J** and owing to the super-thin phosphorus technology, we successfully obtained the end efficiency of 2.39µmol/J at the power of 100W. This value was obtained during a measurement of aCOB LED and 2.1A voltage of **105W** applied to the examined LED.

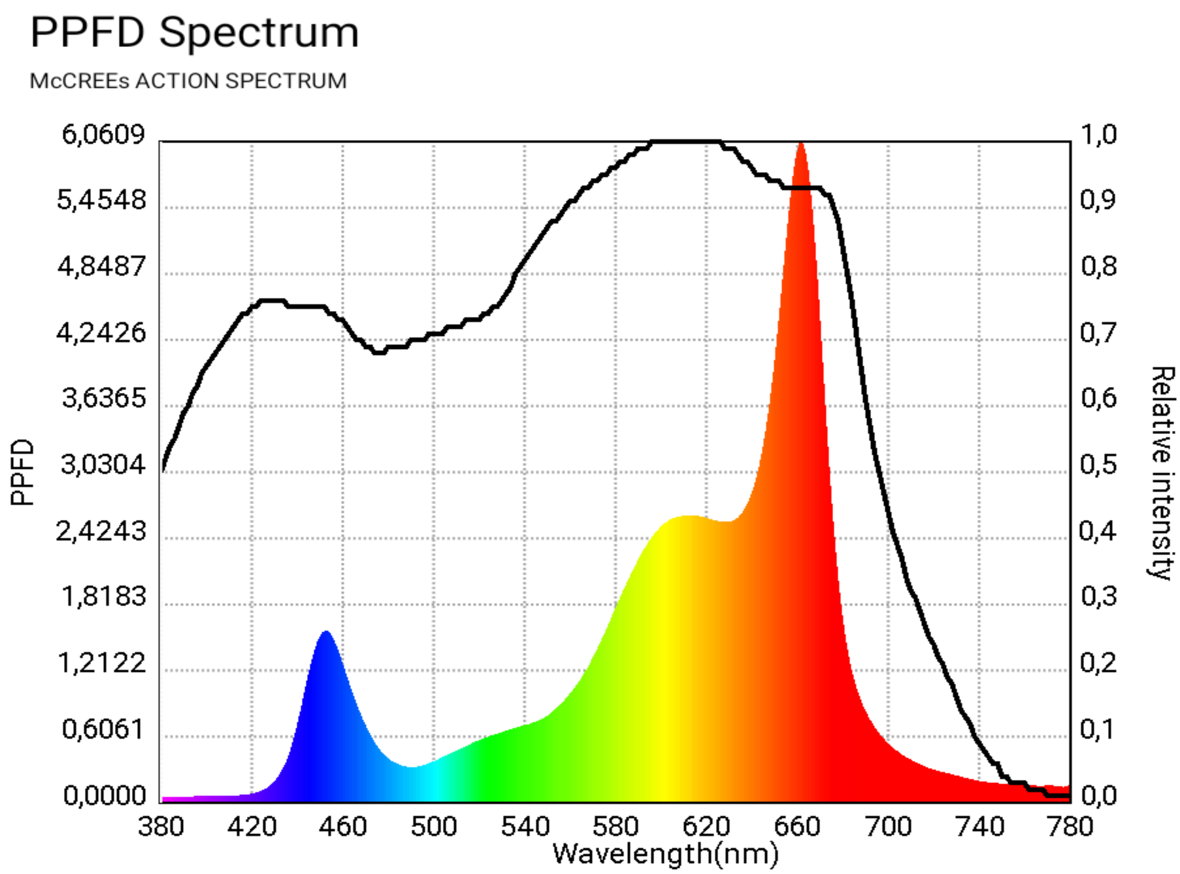


Additionally, such a solution is free of the error of a spectrum that is not suitable for the needs of a plant, as in the case of the 4000K white diode, and owing to the perfect distribution of the band it was possible to use the advantages of the blue diode to the maximum, which was supplemented by a **660nm** red diode.

The **red diode** we used is a 660nm 4W emitter based on a twin technology of Osram OSLON® Square diode, owing to which it perfectly supplements the absent band of the COB diode in the range of 620-680nm, and is additionally characterised by the efficiency of **3.41µmol/J** at 700mA.



Below is the result of this perfect cooperation between COB technology and the red diode.



Let's talk numbers.

Parameters of the AGRO 850 Illuminator

- Total power 854W
- Total photonic intensity PPF 2250µmol/s
- Photonic efficiency 400-700nm 2.64µmol/J
- Heat emission 511W
- Weight of the luminaire 8.9kg
- Dimensions 40x25x15cm
- Optical system boric glass
- Tightness class IP67
- Electric breakdown resistance >7KV
- Estimated operation >62 000h / 20 years
- Guarantee 5 years

The compact structure and exceptionally efficient cooling system ensure high efficiency throughout many years of continuous operation. Particular attention should be put on the compact structure of the highly efficient active cooling system that ensures high efficiency throughout many years of continuous operation. To this end, we have used unique ventilators that satisfy the requirements of IP67 class regarding tightness and resistance to water and dust, owing to which our illuminators work at a considerably lower temperature than those with passive cooling systems. Additionally, the power system i salso cooled, which improves its longevity that is estimated at over 20 years.

Prepared by: Tomasz Braczkowski – http://spectrolight.pl/

Film about how our components are manufactured - Spectro light production

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[i] Green Light Drives Leaf Photosynthesis More Efficiently than Red Light in Strong White Light: Revisiting the
Enigmatic Question of Why Leaves are Green
Ichiro Terashima Takashi Fujita Takeshi Inoue Wah Soon Chow Riichi Oguchi
Plant and Cell Physiology, Volume 50, Issue 4, April 2009, Pages 684–697,

[ii] Pietrzykowski J.: Bezpieczeństwo fotobiologiczne sztucznych i naturalnych źródeł promieniowania optycznego. Part 1: LUX Magazyn issue no. 2, 54-57 (2015). Part 2: LUX Magazyn issue no. 3, 59-66 (2015)