



VitaLightD[®]
a brand of Hugo Lahme GmbH

LED-Information

Hugo Lahme
Perfection in every element.



Hugo Lahme Headquarters in Ennepetal

Hugo Lahme - The Company

For more than 60 years the name Hugo Lahme has stood for highest standards and quality in swimming pool technology. The around 70 employees of the traditional Ennepetaler company devote themselves today with as much passion in the development of optimal solutions for quality swimming pools, pools and aquatic attractions as did the employees there at the beginning. Hugo Lahme GmbH has not only witnessed at first hand, but also actively shaped the development of swimming pool technology. The brands **FitStar**[®], **VitaLight**[®], **AllFit**[®] and **SpringFit**[®] offer top quality in their respective fields for products of bronze, gun metal and stainless steel.

The company has succeeded in applying the extensive knowledge of materials and production techniques gained and developed further over the years and in setting the standards for this sector. The numerous patents, registered designs, TÜV certificates and test certificates bear witness to this.

Constant innovation and ongoing development work at Hugo Lahme have led to optimal solutions with maximum customer benefit - and to highest quality, durability and lasting value: This is now, as then, the requirement that all Hugo Lahme products must meet -

perfection in every element.

Energy-efficient underwater lighting has an immense potential for savings

VitaLight® POWER LED underwater spotlights minimise operating costs and conserve resources

With rising costs of energy many swimming pool operators are faced with the challenge of operating public baths more energy efficiently and conserving resources. This applies primarily to frequently costly underwater lighting in swimming pools. With a range of innovative POWER LED underwater spotlights from the VitaLight® brand Hugo Lahme GmbH offers highest quality, durability and efficiency in this sector. Thus with the new VitaLight® POWER LED spotlights not only impressive and evocative illumination can be achieved, but also an effective reduction of energy and maintenance costs in the long run.

Greater energy efficiency

VitaLight® POWER LED underwater spotlights equate in their performance to equivalent halogen spotlights, but need approximately 80% less energy. So they pay for themselves in a very short time. If account is taken of the considerably longer life expectancy of VitaLight® underwater spotlights of 17 years on average without changing any illuminants and the substantially lower electricity consumption, then it becomes clear that this technology has an enormous potential for savings.

To calculate the economic viability of its POWER LED underwater spotlights, Hugo Lahme has carried out comparative calculations and presents the convincing results. In each case a Halogen 400 W, a Halogen 200 W, a Halogen 175 W and a POWER LED 24 x 3 W underwater spotlight were compared in terms of purchase price and operating cost. An operating time of 2,880 hours with a computational electricity price of 23 Ct/kWh were used as the basis. This equates to 9 hours operation on 320 days/year. The result: VitaLight® POWER LED underwater spotlights pay for themselves in less than two years, in spite of a higher purchase price. The VitaLight® LED spotlights score especially well in the operating costs and at only 49 € per year running costs show an enormous savings potential in comparison with the competition. In comparison: the operating costs for conventional spotlights are up to 962 € per year. The sums mentioned include electricity costs and the cost of lamps including replacing them. Calculated for a period of ten years, POWER LEDs have total operating costs of only approximately 490 € for electricity, as LED spotlights need no changing of

illuminants during their total life expectancy of up to 17 years (= 50,000 operating hours!). This compares with total operating costs of up to 9,619 € for 400 W Halogen spotlights and around 6,700 € for 200 or 175 W Halogen spotlights. And this comparison calculation is for just one single underwater spotlight. When the numbers are increased accordingly, the large savings potential becomes even clearer. The complete data for the comparison calculations can be seen in the table on page 5.

Best lighting and optimal ease of use

The performance of the VitaLight® POWER LED underwater spotlights is also impressive with up to 114 Lumen/Watt.

This allows excellent and effective lighting of pools and swimming pools of any shape. Depending on the version, VitaLight® POWER LED underwater spotlights are available with 4 x 3 W, 12 x 3 W and 24 x 3 Watt. For spotlight insertion modules for underwater windows there is also a 2 x 24 x 3 W version. For different ambiances there are LEDs in the white colour temperatures warm white (3.000 K), neutral white (4.500 K) and daylight white (6.000 K), as well as RGB version and other colours such as blue, red, green and amber. So from the beginning the spotlights can be selected to optimally suit the desired colour setting of any desired light situation.

With the 5 or 10 m silicone cable supplied with the light the VitaLight® POWER LED underwater spotlight can be installed or retro-fitted quickly and easily in all types of swimming pools. All VitaLight® POWER LED spotlights are of course compatible with each other and can easily be controlled and operated by button, radio or DMX.

Highest quality and safety – "Made in Germany" of course

VitaLight® POWER LED underwater spotlights from Hugo Lahme are manufactured completely in Germany in the highest quality from corrosion-resistant gun metal or bronze and stainless steel. The use of gun metal or bronze offers many quality



Flamingo Spa, Vantaa (Finland)



Flamingo Spa, Vantaa (Finland)



Flamingo Spa, Vantaa (Finland)



Green Village Lignano (Italy)





advantages. Due to their rough surfaces the built-in components hold excellently in concrete, do not become brittle with time and cannot break. The whole experience and extensive know how of Hugo Lahme, which the company has gained in metal casting since it was founded in 1945, is used in the manufacture of the high quality gun metal and bronze components. Professional assembly of the spotlights is carried out by the trained hands of the Hugo Lahme specialists at Ennepetal.

Along with being made of high quality materials, VitaLight[®] POWER LED spotlights comply with Protection Class III IP 68 and are provided with safety glass panes 4 mm thick. Furthermore, the spotlights from Hugo Lahme are the only ones on the market complying with all safety tests and EU standards and thus always guarantee safe use.

The standards met are as follows:

- **Low Voltage Directive**
(EN 61347-2-13)
- **Filament lamps standard**
(EN 61047)
- **Radio disturbance standard**
(EN 55015)
- **EMC immunity requirements**
(EN 61547:1955)
- **Line current - ripple current standard**
(EN 61000-3-2)
- **Voltage fluctuations and flicker standard**
(EN 61000-3-3)
- **Laser class I**
(EN 60825-1)
- **DALI Standard**
(IEC 62386-207)
- **VDE and CE conformity**

Costs comparisons of 24 x 3 W LED, 400 W halogen, 200 W halogen and 175 W halogen underwater spotlights

Type underwater spotlight	LED UWS 24 x 3 W	Halogen UWS 400 W	Halogen UWS 200 W	Halogen UWS 175 W
				
Lamp power (W)	72	400	200	175
Energy requirement of transformer or power supply (W)	2	50	45	30
Daily operating time (h)	9	9	9	9
Yearly operating time (days)	320	320	320	320
Yearly operating time (h)	2880	2880	2880	2880
Computational electricity price (Ct/kWh)	23	23	23	23
Yearly electricity consumption (kW)	213,12	1.296,00	705,60	590,40
= annual electricity costs for the lighting	49,02 €	298,08 €	162,29 €	135,79 €
Ø Life expectancy of illuminants (h)	50.000	1000	1.000	1.000
Cost of illuminants	950,00 €	150,50 €	96,30 €	105,60 €
Number of illuminant replacements (year)	0	3	3	3
= Costs of illuminants per year	0,00 €	436,45 €	277,34 €	304,13 €
Service cost of replacing illuminants	80,00 €	80,00 €	80,00 €	80,00 €
Number of illuminant replacements (year)	0	3	3	3
= Cost of illuminant replacements (year)	0,00	240,00	240,00	240,00
= running costs per year	49,02 €	974,53 €	679,63 €	679,92 €
Purchase price of an underwater spotlight (Gross list price incl. power supply)	1.517,00 €	910,90 €	793,10 €	663,10 €
Amortisation time halogen to LED (years)	-	0,65	1,15	1,35

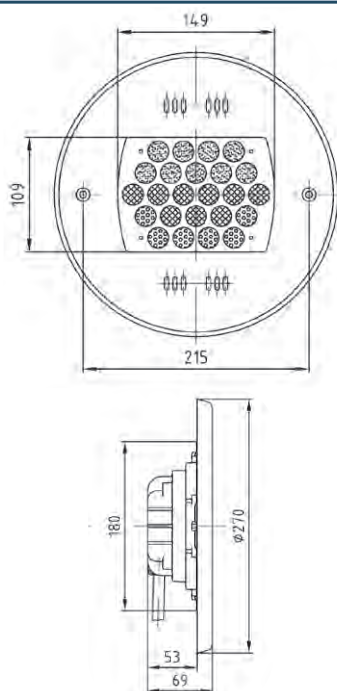
Comparison of operating costs halogen to LED over 10 years

	LED UWS 24 x 3 W	Halogen UWS 400 W	Halogen UWS 200 W	Halogen UWS 175 W
Accumulated electricity costs	490,18 €	2.980,80 €	1.622,88 €	1.357,92 €
Number of illuminant replacements (rounded)	0	29	29	29
Cost of illuminants	0,00 €	4.364,50 €	2.773,44 €	3.041,28 €
Cost of replacing illuminants	0,00 €	2.400,00 €	2.400,00 €	2.400,00 €
= Total operating costs LED and halogen (for one spotlight)	490,18 €	9.745,30 €	6.796,32 €	6.799,20 €

Technical Support

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Technical drawing



POWER LED underwater spotlights 24 x 3 W with mixed lenses



	LED colour	White 8000 K	Daylight white 6000 K	Neutral white 4500 K	Warm white 3000 K	Blue	RGB
cable length code	5 m	4380520/21	4380020/21	4380420/21	4380320/21	4380120/21	4380220/21
Gun metal/bronze	10 m	on request	4360620/21	on request	on request	4360720/21	4360820/21

Tender text

VitaLight[®] POWER LED underwater spotlight of corrosion resistant gun metal with processor-controlled board and safety glass pane with special underwater cable (5 or 10 m length) connected. Stainless steel cover (316L/316Ti). O-ring and seal of silicone.

Further information:

The VitaLight[®] underwater spotlight is only suitable for operating underwater. The recommended installation depth is 600 mm below water level. For use in salt water, mineral or thermal baths a special Gbz10 (cast bronze) alloy is necessary. The underwater spotlights are available from stock with white, blue or RGB-LEDs. Further colours are available on request.

The monochrome underwater spotlight is controlled by a switch. The RGB underwater spotlight can be controlled by a switch, remote radio control or DMX512.

Accessories

- Built-in niche (4100050, 4400020, 4101050)
- Flange set (4060050, 4060020)
- Power unit for 1 monochrome LED spotlight with 24 x 3 W (4380050)
- Ballast for 1 RGB LED spotlight with 24 x 3 W (4380150)
- Power unit for up to 2 monochrome LEDs spotlight with 24 x 3 W (4380650)
- Ballast for up to 2 RGB LED spotlights with 24 x 3 W (4380750)
- Radio receiving module with aerial (576828)
- Radio remote control (576829)
- DMX512 plug-in module with cable (576841)

Technical data

Aperture diameter:	270 mm
Life expectancy:	50.000 operating hours
Colour temp. (white):	8000 K, 6000 K, 4500 K, 3000 K
Protection class:	III IP 68
Rating:	24 x 3 W
Current / voltage:	700mA, 12V/DC SELV
Light output:	7200 lm
Light output max.:	max. 114 lm/W at 8000 K
Laser classification:	EN 60825-1, Laser classification I
Beam angle:	80° horizontal, 45° vertical (mixed lenses)
Safety:	LED assemblies protection-coated against opto-electronic influences and damp. LEDs temperature-monitored.
Economics:	The performance of the monochrome POWER LED underwater spotlight corresponds approximately to that of a 400 W halogen spotlight with about only 20 % of its energy consumption. The RGB model has about 70 % of the performance of a monochrome LED underwater spotlight.

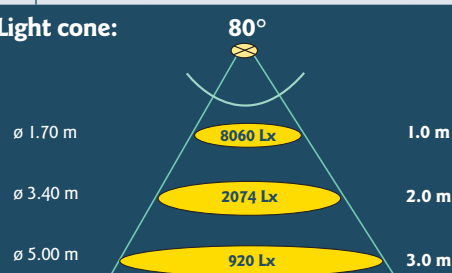




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Light cone:

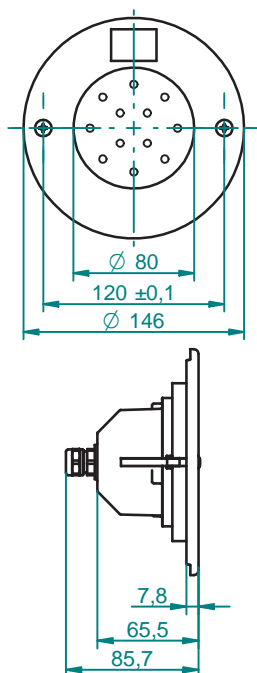


Technical Support	POWER LED underwater spotlights 12 x 3 W, 60° lenses																																	
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Technical drawing																																		
																																		
	<table><tr><td></td><td>LED colour</td><td>Daylight white 6000 K</td><td>Neutral white 4500 K</td><td>Warm white 3000 K</td><td>Blue</td><td>RGB</td></tr><tr><td>cable length</td><td>5 m</td><td>4147020/21</td><td>4146020/21</td><td>4145020/21</td><td>4148020/21</td><td>4149020/21</td></tr><tr><td>code</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Gun metal/bronze</td><td>10 m</td><td>on request</td><td>on request</td><td>on request</td><td>on request</td><td>on request</td></tr></table>							LED colour	Daylight white 6000 K	Neutral white 4500 K	Warm white 3000 K	Blue	RGB	cable length	5 m	4147020/21	4146020/21	4145020/21	4148020/21	4149020/21	code							Gun metal/bronze	10 m	on request	on request	on request	on request	on request
	LED colour	Daylight white 6000 K	Neutral white 4500 K	Warm white 3000 K	Blue	RGB																												
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Gun metal/bronze	10 m	on request	on request	on request	on request	on request																												
	Tender text																																	
	<p>VitaLight® POWER LED underwater spotlight of corrosion resistant gun metal with processor-controlled board and safety glass pane with special underwater cable (5 or 10 m length) connected. Stainless steel cover (316L/316Ti). O-ring and seal of silicone.</p> <p><u>Further information:</u></p> <p>The VitaLight® underwater spotlight is only suitable for operating underwater. The recommended installation depth is 600 mm below water level. For use in salt water, mineral or thermal baths a special Gbz10 (cast bronze) alloy is necessary. The underwater spotlights are available from stock with white, blue or RGB-LEDs. Further colours are available on request.</p> <p>The monochrome underwater spotlight is controlled by a switch. The RGB underwater spotlight can be controlled by a switch, remote radio control or DMX512.</p>																																	
Accessories	Technical data																																	
- Built-in niche (4100050, 4400020, 4101050)	Aperture diameter:	270 mm																																
- Flange set (4060050, 4060020)	Life expectancy:	50.000 operating hours																																
- Power unit for up to 2 monochrome LED spotlights with 12 x 3 W (4380050)	Colour temp. (white):	6000 K, 4500 K, 3000 K																																
- Ballast for up to 2 RGB LED spotlights with 12 x 3 W (4380150)	Protection class:	III IP 68																																
- Power unit for up to 4 monochrome LED spotlights with 12 x 3 W (4380650)	Rating:	12 x 3 W																																
- Ballast for up to 4 RGB LED spotlights with 12 x 3 W (4380750)	Current / voltage:	700mA, 12V/DC SELV																																
- Radio receiving module with aerial (576828)	Light output:	3600 lm																																
- Radio remote control (576829)	Light output max.:	max. 100 lm/W at 6000 K																																
- DMX512 plug-in module with cable (576841)	Laser classification:	EN 60825-1, Laser classification I																																
	Safety:	LED assemblies protection-coated against opto-electronic influences and damp. LEDs temperature-monitored.																																
		The RGB model has about 70% of the performance of a monochrome LED underwater spotlight.																																
Production and distribution																																		
Hugo Lahme GmbH Kahlenbecker Str. 2 58256 Ennepetal Tel. +49 (0) 23 33 / 96 96 0 Fax +49 (0) 23 33 / 96 96 46 info@lahme.de - www.lahme.de	<div><div>Light cone:</div><div></div></div>																																	
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Technical Support

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Technical drawing



POWER LED underwater spotlights 12 x 3 W, 120° lenses



	LED colour	Daylight white 6000 K	Neutral white 4500 K	Warm white 3000 K	Blue	RGB
cable length code	5 m	4269520/21	4269920/21	4269820/21	4269620/21	4269720/21
Gun metal/bronze	10 m	4360020/21	on request	on request	on request	4360220/21

Tender text

VitaLight[®] POWER LED underwater spotlight of corrosion resistant gun metal with processor-controlled board and safety glass pane with special underwater cable (5 or 10 m length) connected. Stainless steel cover (316L/316Ti). O-ring and seal of silicone.

Further information:

The VitaLight[®] underwater spotlight is only suitable for operating underwater. The recommended installation depth is 600 mm below water level. For use in salt water, mineral or thermal baths a special Gbz10 (cast bronze) alloy is necessary. The underwater spotlights are available from stock with white, blue or RGB-LEDs. Further colours are available on request.

The monochrome underwater spotlight is controlled by a switch. The RGB underwater spotlight can be controlled by a switch, remote radio control or DMX512.

Accessories

- Built-in niche (4266050, 4266020)
- Flange set (4267050)
- Power unit for up to 2 monochrome LED spotlights with 12 x 3 W (4380050)
- Ballast for up to 2 RGB LED spotlights with 12 x 3 W (4380150)
- Power unit for up to 4 monochrome LED spotlights with 12 x 3 W (4380650)
- Ballast for up to 4 RGB LED spotlights with 12 x 3 W (4380750)
- Radio receiving module with aerial (576828)
- Radio remote control (576829)
- DMX512 plug-in module with cable (576841)

Technical data

Aperture diameter:	146 mm
Life expectancy:	50.000 operating hours
Colour temp. (white):	6000 K, 4500 K, 3000 K
Protection class:	III IP 68
Rating:	12 x 3 W
Current / voltage:	700mA, 12V/DC SELV
Light output:	3600 lm
Light output max.:	max. 100 lm/W at 6000 K
Laser classification:	EN 60825-1, Laser classification I
Safety:	LED assemblies protection-coated against opto-electronic influences and damp. LEDs temperature-monitored.
	The RGB model has about 70% of the performance of a monochrome LED underwater spotlight.

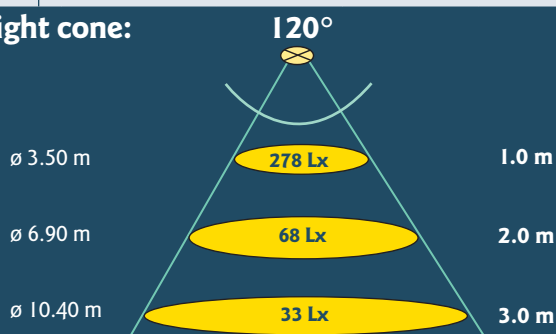


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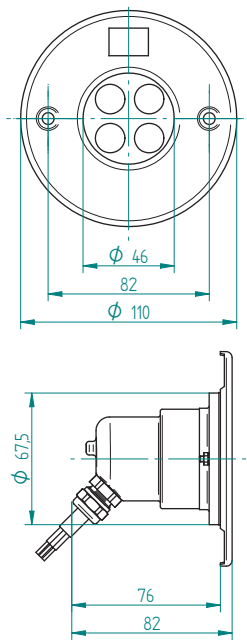
Light cone:



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Technical drawing



POWER LED Unterwasserscheinwerfer 4 x 3 W



	LED colour	Daylight white 6000 K	Neutral white 4500 K	Warm white 3000 K	Blue	RGB
cable length code	5 m	4320020/21	4322520/21	4322220/21	4320520/21	4320720/21
Gun metal/bronze	10 m	on request	on request	on request	on request	on request

Tender text

VitaLight® POWER LED underwater spotlight of corrosion resistant gun metal with processor-controlled board and safety glass pane with special underwater cable (5 or 10 m length) connected. Stainless steel cover (316L/316Ti). O-ring and seal of silicone. Particularly suitable for installation in steps, recesses or lighting as an aid to orientation.

Further information:

The VitaLight® underwater spotlight is only suitable for operating underwater. For use in salt water, mineral or thermal baths a special Gbz10 (cast bronze) alloy is necessary. The underwater spotlights are available from stock with white, blue and RGB-LEDs. Further colours are available on request.

The monochrome underwater spotlight is controlled by a switch. The RGB underwater spotlight can be controlled by a switch, remote radio control or DMX512.

Accessories

- Built-in niche (4250050, 4250020)

- Flange set (4251050)

- Ballast 4 POWER LEDs RGB (4330250)

- Power unit for monochrome POWER LEDs:
for 4 POWER LEDs (4330050)
for 8 POWER LEDs (4330150)

- Radio receiving module with aerial
(576828)

- Radio remote control (576829)

- DMX512 plug-in module with cable (576841)

Technical data

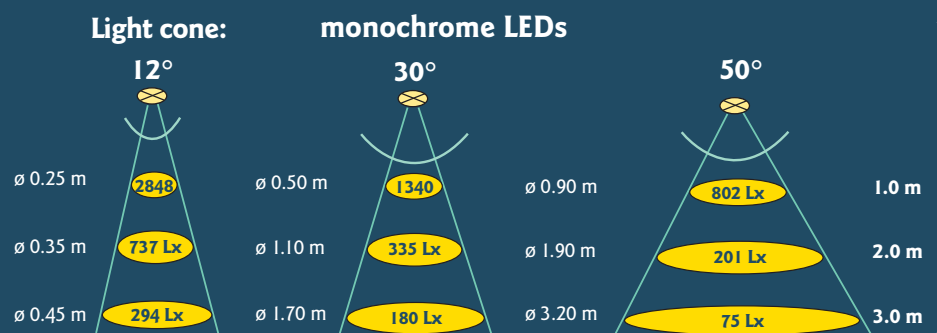
Aperture diameter:	110 mm
Life expectancy:	50.000 operating hours
Colour temp. (white):	6000 K, 4500 K, 3000 K
Protection class:	III IP 68
Rating:	4 x 3 W
Current / voltage:	700mA, 12V/DC SELV
Light output:	1200 lm
Light output max.:	max. 100 lm/W at 6000 K
Safety:	LED assemblies protection-coated against opto-electronic influences and damp. LEDs temperature-monitored.
Beam angle:	12°, 30° or 50°
	The RGB model has about 70% of the performance of a monochrome LED underwater spotlight.



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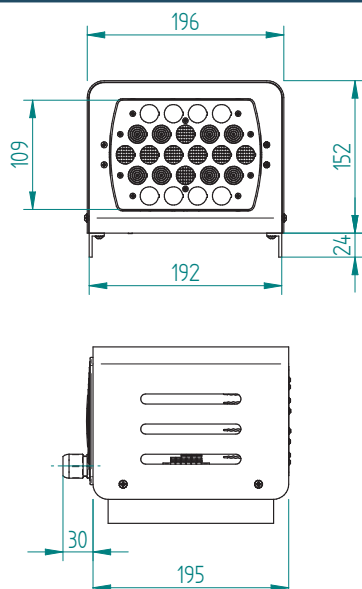
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Technical drawing



POWER LED spotlight insertion modules 24 x 3 W



LED colour	White 8000 K	Daylight white 6000 K	Blue	RGB
Art.-Nr.	4640450	4640750	4640550	4640650

Tender text

VitaLight[®] POWER LED spotlight insertion module for underwater windows of blue coated aluminium with a processor-controlled board, integrated ventilator and connected silicone cable (5 m long). The board is vertically pivotable by up to 10°.

Further information:

The VitaLight[®] POWER LED spotlight insertion module for underwater windows is only suitable for operation in a dry environment. The recommended installation depth is 600 to 800 mm below water level in an underwater window. The minimum diameter of the underwater window is 250 mm (use without housing base) or 285 mm (use with housing base).

The spotlight modules are available from stock with white, blue and RGB-LEDs. Further colours are available on request. Also available with bracket for use as ceiling lighting. The spotlight insertion modules are controlled by a switch, remote radio control or DMX512.

Accessories

- Power unit for 1 monochrome spotlight insertion module 24 x 3 W POWER LED (4380050)
- Ballast for 1 RGB spotlight insertion module 24 x 3 W POWER LED (4380150)
- Power unit for 2 monochrome spotlight insertion modules 24 x 3 W POWER LED (4380650)
- Ballast for 2 RGB spotlight insertion modules 24 x 3 W POWER LED (4380750)
- Radio receiving module with aerial (576828)
- Radio remote control (576829)
- DMX512 plug-in module with cable (576841)

Technical data

Dimensions:	H 176 mm (with base) 152 mm (without base) / B 192 mm (at bottom) 196 mm (at top) / T 195 mm
Life expectancy:	50.000 operating hours
Colour temp. (white):	8000 K / 6000 K
Protection class:	III IP 20
Rating:	24 x 3 W
Light output:	8300 lm
Light output max.:	max. 114 lm/W at 8000 K
Safety:	LED assemblies protection-coated against opto-electronic influences and damp. LEDs temperature-monitored.
	The RGB model has about 70% of the performance of a monochrome LED underwater spotlight.

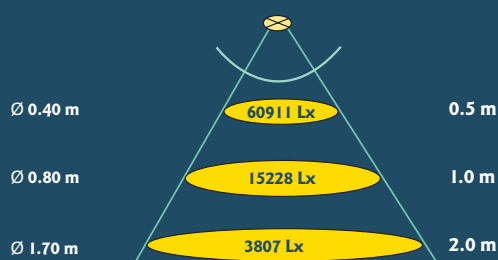


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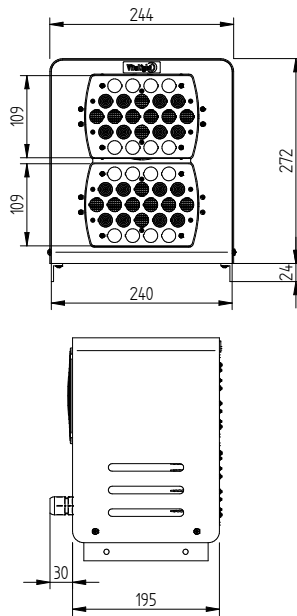
Light cone 45°



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Technical drawing



POWER LED spotlight insertion modules 2 x 24 x 3 W



LED colour	White 8000 K	Daylight white 6000 K	Blue	RGB
Art.-Nr.	4640050	4640350	4640150	4640250

Tender text

VitaLight[®] POWER LED spotlight insertion modules for underwater windows of blue coated aluminium with two processor-controlled boards, integrated ventilator and connected silicone cable (2 m long). The boards are vertically pivotable by up to 10°.

Further information:

The VitaLight[®] POWER LED spotlight insertion modules for underwater windows is only suitable for operation in a dry environment. The recommended installation depth is 600 to 800 mm below water level in an underwater window. The minimum dimensions of the underwater window are 400 mm x 400 mm square or a diameter of 400 mm with round underwater windows.

The spotlight insertion modules are available from stock with white, blue and RGB-LEDs. Further colours are available on request. The spotlight insertion modules are controlled by a switch, remote radio control or DMX512.

Accessories

- Power unit for a monochrome board of the spotlight insertion module 2 x 24 x 3W POWER LED (4380050)
- Ballast for an RGB board of the spotlight insertion module 2 x 24 x 3W POWER LED (4380150)
- Power unit for 2 monochrome boards of the spotlight insertion module 2 x 24 x 3W POWER LED (4380650)
- Ballast for 2 RGB boards of the spotlight insertion module 2 x 24 x 3W POWER LED (4380750)
- Radio receiving module with aerial (576828)
- Radio remote control (576829)
- DMX512 plug-in module with cable (576841)

Technical data

Dimensions:	H 296 mm (with base) 272 mm (without base) / B 240 mm (at bottom) 244 mm (at top) / T 195 mm
Life expectancy:	50.000 operating hours
Colour temp. (white):	8000 K / 6000 K
Protection class:	III IP 20
Rating:	2 x 24 x 3 W
Light output:	16600 lm
Light output max.:	max. 114 lm/W at 8000 K
Safety:	LED assemblies protection-coated against opto-electronic influences and damp. LEDs temperature-monitored.
	The RGB model has about 70% of the performance of a monochrome LED underwater spotlight.

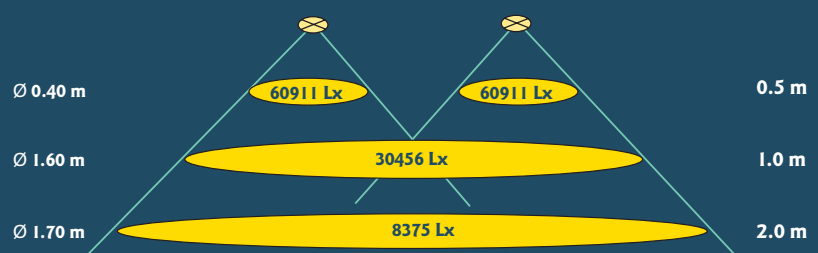


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Subject to technical changes !

Light cone 45°



Hugo Lahme in the press

Extract from AB Archiv des Badewesens 7/2011:

Savings potential in swimming pools with underwater lighting thanks to LED-technology

On the history, principles and characteristics of a future-oriented technology

Dipl.-Ing. Werner Markenstein, Hugo Lahme GmbH, Ennepetal

The use of LEDs (abbreviation for: Light Emitting Diode) in swimming pools for illumination of the surface of the water or illuminating objects outside of the pool provides an energy efficient and low maintenance alternative to the halogen spotlights used until now in public baths.

Previously only a niche solution for poorly illuminated notices etc., the technological developments in LED technology now encompass numerous other fields of use, such as the field of underwater lighting. But how did this technology develop in recent years, and how does it actually work? What are lumens, lux, colour temperatures etc., of which one speaks so naturally today? This article is intended to provide some answers for a better understanding of LED technology and primarily to show that swimming pool operators now have available an extremely energy-efficient and efficient lighting technology for sustainable construction or the sustainable and forward-looking refurbishment of their swimming pools.

The history of LED technology, an extract

Although the physical effects of electroluminescence were discovered as early as 1907 by the Briton Henry Round, and these were researched further by the Russian Oleg Lossew from 1927 onwards, the

first red light emitting diode did not come onto the market until the beginning of the 1960s. This first early LED opened the path to industrial production and had at the time a light efficiency of 0.1 Lumen/Watt (lm/W).

It then took until the beginning of the 1970s before green, yellow and orange LEDs came onto the market. High performance LEDs with a significantly higher light efficiency established themselves in the market from 1989 onwards. The first blue LED was introduced to the market in 1992 at the request of a car manufacturer and was built into his cars.

From then on the development of LEDs accelerated, as due to the higher light intensity more and more applications for the diodes appeared. Already in 1997 white LEDs with an efficiency of 10 lm/W appeared on the market. This was then developed into the so-called POWER LED, and in this way an efficiency of 40 lm/W was reached in 2004. In 2009 white POWER LEDs in industrial scale production had an efficiency of 100 to 120 lm/W. In September 2010 LEDs which could reach an efficiency of around 220 lm/W were tested under laboratory conditions. It will be interesting to see where the further development of LED technology will lead.

Fundamentals of light - basis of LED technology

What is light?

Light is an electro-magnetic wave. As a result, light has specific properties such as the wavelength λ , the frequency f and the speed of light C or the amplitude (see fig.1). Light is visible when the wavelength lies between 380 nanometre (nm) and 780 nm. A nanometre is 10^{-9} m, which is approximately 70,000 times thinner than a human hair. Light of 380 nm is perceived by the human eye as blue-violet and that at the other end of the light spectrum of 780 nm as red. Light with a wavelength greater than 780 nm is called infra-red or IR light. If it has a wavelength of less than 380 nm it is called ultra-violet or UV light (see fig. 2).

Coloured or white?

LED technology is based on additive colour mixing (see fig. 3). Starting from the basic colours red, green and blue there are also LEDs in yellow and orange. White light is created by LEDs either by the additive colour mixing of the three LED colours red, green and blue (RGB colour range) or by the phosphorising of blue LEDs, which also produces white light. Phosphorising is used more frequently and is also the version producing the most light.

Making light colours measurable

The light colour describes the spectral composition of light and how this is perceived by the human eye. Each colour of light is assigned a corresponding colour temperature, and this is measured in Kelvin (K). Here: 1° Celsius (C) corresponds to 273 K. The colour temperature - spectrally following Planck's radiation law - corresponds to the temperature of an incandescent radiating body. With a rising temperature the light becomes correspondingly bluer and by reducing temperatures red. This is the reason for the light of a glowing hotplate appearing red, the light of a candle yellow, the light of the sun white and the light of very hot fixed stars blue.

One can therefore note that higher Kelvin values of colour temperature are perceived by humans as being rather colder because they are blue, and lower Kelvin values as rather warmer because they are red.

Is this too technical? Then here are some understandable examples:

Light source	Colour temperature
Candle	1500 K
Light bulb	2600 - 2900 K
Halogen light	3000 K
Fluorescent tube (warm white)	3000 K
Fluorescent tube (neutral white)	4500 K
Xenon lamp, arc light	5000 K
Midday sun	5500 K
LED (daylight white)	6000 K
Blue sky	8000 - 10 000 K

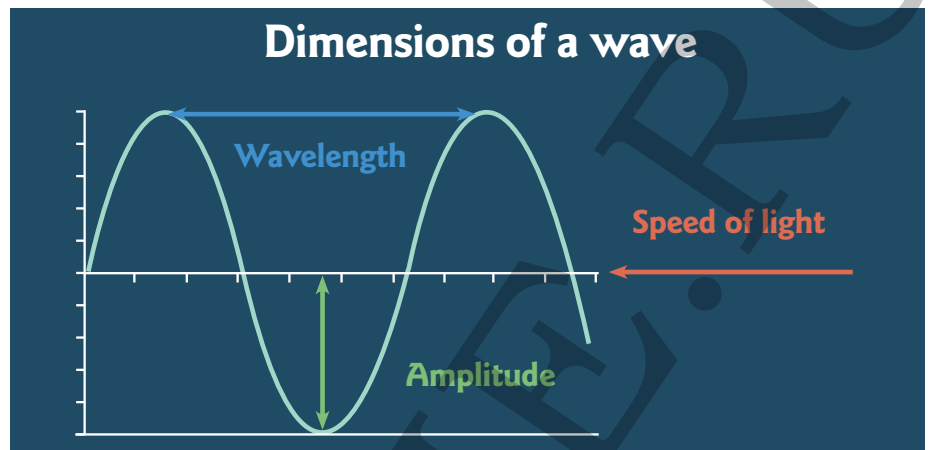


Fig. 1: Sizes of a light wave

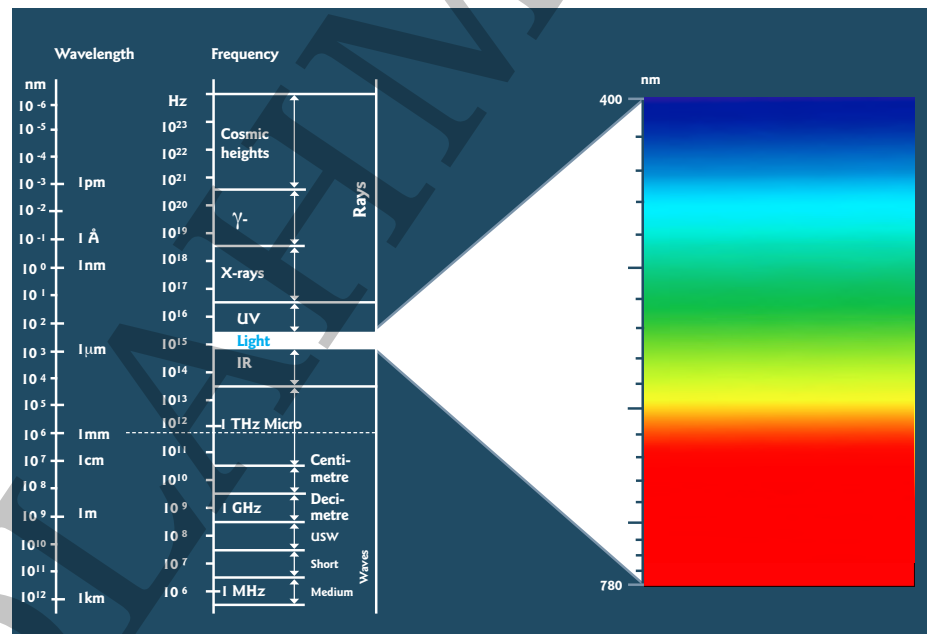


Fig. 2: Visible light and radiation



Fig. 3: Additive colour system

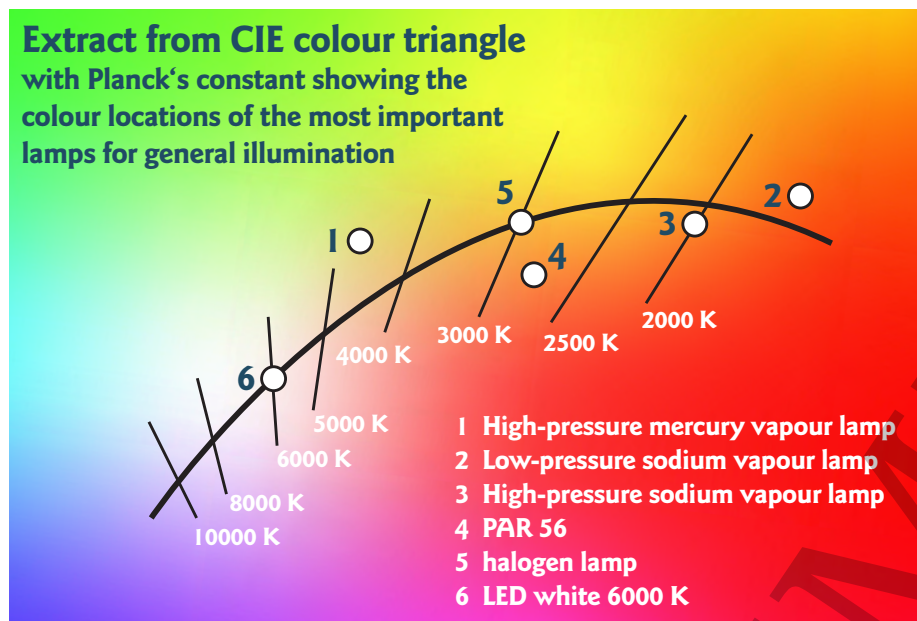


Fig. 4: Colour locations of important lamps in the CIE colour triangle
CIE: Commission internationale de l'éclairage = International Lighting Commission based in Vienna. From the ISO recognised standardisation body for lighting

In figure 4 one can see in the extract from the CIE colour triangle with the Planck colour separation the corresponding colour locations of some important types of lamps.

of about 7 %, and an LED about 25 %. This means that, for example, with an LED 25 % of the current used is conver-

Performance of the halogen spotlight:	50 W
Light yield:	20 lm/W x 50 W = 1000 lm
Light yield POWER LED:	approx. 100 lm/W
Required performance of an LED spotlight:	1000 lm → 1000/100 = 10 W LED

Units of light?

The luminous flux is the light output radiated by a light source. This is measured in lumen (lm). The illumination intensity, however, is the measure of the light flux hitting a defined surface. The lux (lx) unit is used for this. One lux corresponds to one lumen per m² (1 lx = 1 lm/m²). For example, sunshine at midday in the open develops an illumination intensity of 100 000 lx, an office desk has an illumination intensity of around 500 lx, and a clear moonlight night has an illumination intensity of approx. 0.2 lx.

When talking of the efficiency of a lamp, one means the ratio of the emitted optical power to the electrical power used. The efficiency Eta (η) of a light bulb is about 3 %. A halogen lamp has an efficiency

ted into light. The rest is converted into heat which must be removed or cooled down accordingly. The light yield is in turn a measure of the effective conversion of electrical energy into light. It is given in the unit lumen per watt (lm/W). Here light bulbs achieve values between 10 and 15 lm/W, halogen lamps 15 to 20 lm/W.

For fluorescent lamps the value is between 60 and 80 lm/W, and monochrome LEDs today are around 100 to 120 lm/W. It can be easily seen that modern LEDs have advantages over other means of lighting in both efficiency and light yield.

Ergo, the following calculation can be made for the replacement of a 50W halogen spotlight with an LED spotlight:

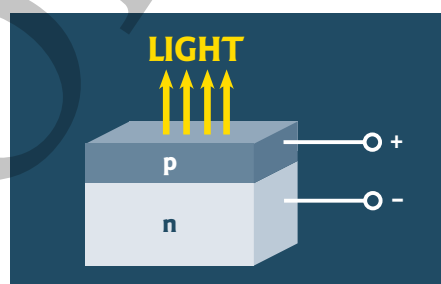


Fig. 6: Construction of an LED chip

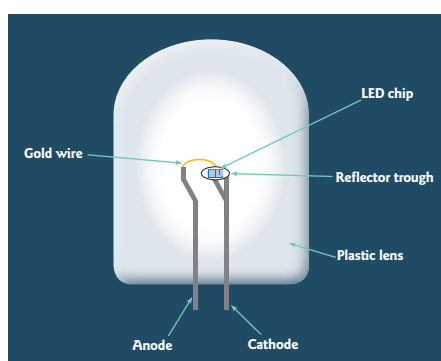


Fig. 5: Construction of an LED

General characteristics of LEDs

The operating principle of an LED

In principle the construction of an LED corresponds to the structure of a semiconductor diode. A diode allows the passage of a current in one direction only. The current flows through an LED chip fixed in the reflector dish. This consists of two layers, where an exchange of electrons takes place at the boundary layer and, simply said, this causes the light effect.

(Figure 5 and 6)

LED in the swimming pool – a technological comparison with halogen

Generally speaking there are two kinds of spotlights used nowadays for underwater lighting in public swimming pools: halogen and LED underwater spotlights.

The two types of spotlights have, amongst other attributes, characteristics which are shown in the following overview:

Particular quality characteristics of high quality LED underwater spotlights are:

- Laser class I
acc. to EN 60 825-1
- VDE-compliant potential isolation of ballasts
- UV resistant protective coating
- Temperature monitoring and current control at the LED board
- Compliance with Low Voltage Directive acc. to EN 61 347
- Compliance with EMC acc. to EN 61 547
- Compliance with DALI standard IEC 62 386-207
- Compliance with filament lamps standard EN 61 047
- VDE- and CE-Conformity

EMV: Electro-Magnetic Compatibility = no reciprocal interference with technical equipment by unwanted electrical or electromagnetic effects



DALI: Digital Addressable Lighting Interface = protocol on control of lighting technology operating equipment such as power supplies, electronic ballasts and dimmers

DMX: Digital Multiplex is a control protocol for spotlights, dimmers and effect devices

Advantages and disadvantages of LEDs

advantages	disadvantages
Resistance to impact and vibration	Large reduction in life expectancy due to too high current at the LED chip with an unregulated power supply
High light yield	Continuous decrease in light over its life
Long service life under normal use	High development costs and purchase price
Lower energy consumption	Complex manufacture and production
No switching time and no switching wear	Necessity of ballasts
Constant colour temperature	
Compact design	
Easily upgradeable	
No heat radiation, therefore especially suitable for illumination of heat-sensitive objects	

Underwater spotlights in comparison

Halogen	LED
	
Versions: 50 W, 2 x 50 W, 2 x 65 W, 175 W; 12 V, 200 W und 400 W; 30 V	Versions: 4 x 3 W, 12 x 3 W, 24 x 3 W; 12 V
Life expectancy approx. 1000 operating hours	Life expectancy approx. 50000 operating hours
Medium investment	High initial investment, but quick amortisation
High energy consumption	Low energy consumption
Low energy efficiency	High energy efficiency
Operates with safe low voltage	Operates with safe low voltage
Safety glass	Safety glass
Not DMX capable	DMX capable
Changing of illuminant easily with filled pool	Changing of illuminants not necessary
Ultraviolet (UV) and infra-red (IR) rays	No ultraviolet (UV) and infra-red (IR) rays
GS tested	GS tested
High maintenance costs	No maintenance costs
High quality construction of gunmetal, bronze and stainless steel 316L/316Ti	High quality construction of gunmetal, bronze and stainless steel 316L/316Ti
Colour change not possible	Colour change possible
	Very flat construction possible
Colour temperature approx. 3400 K	Colour temperatures: 8000 K, 6000 K, 4500 K und 3000 K

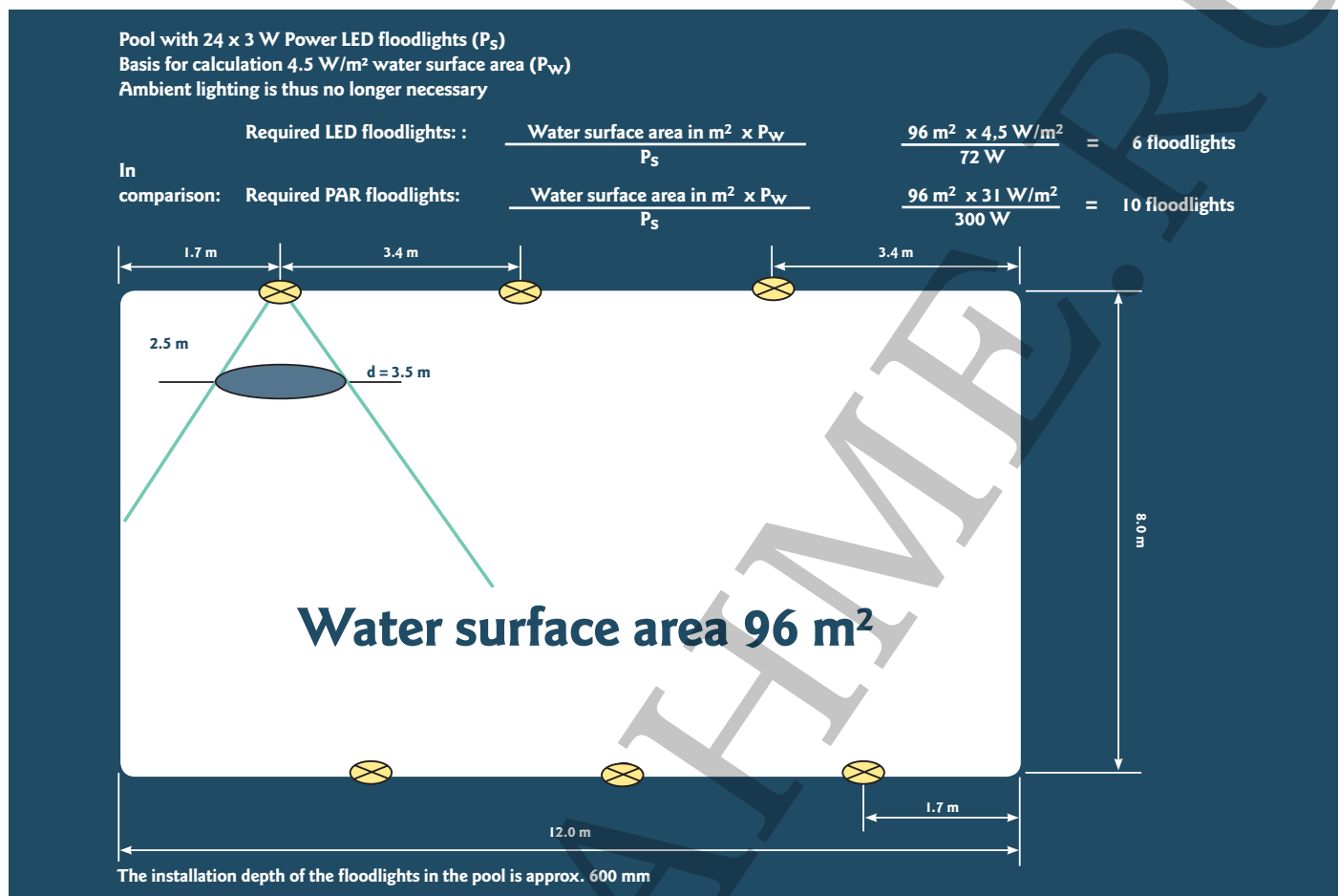


Fig. 7: Example of calculation for pool lighting in a 12 x 8 m pool

It is clear that LED underwater spotlights have a favourable energy balance and at the same time combine long-term durability with low maintenance. For good underwater illumination one needs with halogen spotlights approx. 20 - 25 W/m² water surface with a desired illumination of 300 to 500 lm/m². In the case of LEDs one needs for white LEDs approx. 3 - 5 W/m² water surface and with RGB-LEDs approx. 5 - 7 W/m² water surface in order to have the same illumination (see Fig. 7).

Economy – the be all and end all of our time

Especially the economic illumination of swimming pools is sustainably ensured by LED technology. A comparative calculation and cost comparison show the savings potential. In the following, 400 W, 200 W and 175 W Halogen and 24 x 3 W LED underwater spotlights are compared.

An operating time of 2880 hours with a computational electricity price of 23 ct/kWh were used as the basis. This equates to 9 hours operation on 320 days/year. It can be seen that despite the much higher purchase price the LED spotlights pay for themselves in less than two years.

Particularly the running costs of around only 49 €/year in comparison to approx. 962 €/year for a 400 W halogen spotlight and approx. 670 €/year for 200 and 175 W halogen spotlights are particularly attractive to swimming pool operators. The running costs include the costs of electricity, illuminants and the cost of replacing them. With the electricity costs alone savings of between 84 % (400 W halogen) and 70 or 64 % (200 W or 175 W Halogen) can be realised.

In addition, with the LEDs no costs are incurred for the replacement of illuminants, which is often costly and time intensive.

Extrapolating this data up to ten years - which is not even the average life expectancy of the LEDs, which is around 17 years - then the total operating costs of an LED are only 490 €. For 400 W halogen spotlights these costs are around 9619 €, and for 200 W or 175 W halogen spotlights around 6700 €. And this comparative calculation is based on only one single spotlight; increase the number and the immense saving potential of LED technology is even more evident.

The individual data are listed in the table alongside.

Underwater spotlights	Halogen 400 W	Halogen 200 W	Halogen 175 W	LED 24 x 3 W
Lamp power in Watt	400	200	175	72
Energy requirement of transformer or power supply	50	45	30	2
Daily operating time in hours	9	9	9	9
Annual operating time in days	320	320	320	320
Annual operating time in hours	2880	2880	2880	2880
Electricity price ct/kWh	23	23	23	23
Electricity consumption in kW/year	1296	705,6	590,4	213,12
Annual electricity costs for the lighting	298,08 €	162,29 €	135,79 €	49,02 €
Annual saving in electricity cost per spotlight in % (400 W halogen)				84 %
Annual saving in electricity cost per spotlight in % (200 W halogen)				70 %
Annual saving in electricity cost per spotlight in % (175 W halogen)				64 %
Life expectancy of illuminants in hours	1000	1000	1000	50000
Cost of illuminants in € (acc. to price list, gross)	150,50 €	96,30 €	105,60 €	950,00 €
Number of illuminant replacements (year)	2,9	2,9	2,9	0,0
Costs of illuminants per year and spotlight	433,44 €	277,34 €	304,13 €	0 €
Service cost of replacing an illuminant in €	80,00 €	80,00 €	80,00 €	80,00 €
Number of illuminant replacements per year	2,9	2,9	2,9	0,0
Costs of replacing illuminants per year and spotlight	230,40 €	230,40 €	230,40 €	0 €
Operating costs per year and spotlight	961,92 €	670,03 €	670,32 €	49,02 €
Purchase price of 1 underwater spotlight incl. power supply (acc. to price list, gross)	910,90 €	793,10 €	663,10 €	1.517,00 €
Additional price LED over halogen 400 W				606,10 €
Additional price LED over halogen 200 W				723,90 €
Additional price LED over halogen 175 W				853,90 €
Amortisation time of the LED lights compared to halogen lights without interest in years	0,66	1,17	1,37	
Comparison of operating costs over 10 years				
Electricity costs of the underwater spotlights over 10 years	2.980,80 €	1.622,88 €	1.357,92 €	490,18 €
Illuminant replacements over a 10 year period	29	29	29	0
Costs of illuminants over 10 years	4.334,40 €	2.773,44 €	3.041,28 €	
Costs of replacing illuminants over 10 years	2.304,00 €	2.304,00 €	2.304,00 €	
Total operating costs of halogen and LED underwater spotlights for an operating period of 10 years	9.619,00 €	6.700,00 €	6.703,00 €	490,00 €

Cost comparison of 400 W, 200 W, 175 W halogen and 24 x 3 LED underwater spotlights.



Overall view of several pools in Flamingo Spa in Vantaa, Finland. Easy to recognise is the different illumination by the use of different underwater spotlights. In the pool in the foreground 24 x 3 W LED underwater spotlights have been installed, whilst in the pool on the right halogen underwater spotlights have been used; Photos: Flamingo Spa, Vantaa/Finland



Fitted solely with LED spotlights: the sports pool (above) and the pool in the wellness area

Conclusion

LED underwater spotlights are a sustainable and future-orientated alternative to conventional underwater spotlights.

The enormous savings potential brings big advantages in costs with it and contributes consistently to the economical use of resources. In a cost-conscious and sustainable pool operation, LED underwater spotlights are here to stay.

Hugo Lahme in the press

Extract from AB Archiv des Badewesens 04/2011:

„Autumn meeting“ in Karlsruhe

Committees of the Deutsche Gesellschaft für das Badewesen (German Society for the Spa Industry) were guests in the Baden cultural capital for two days.

Underwater lighting with LED technology

[...] The actual meeting was continued following this in the neighbouring Europahalle, where it had already been held the first day. Dipl.-Ing. Werner Markenstein, Director of Hugo Lahme GmbH, Ennepetal, explained in a very clear way the basics of LED (Light Emitting Diode) technology and showed the economy of using LEDs for underwater lighting in comparison to traditional underwater lighting technology.

Due to the significantly lower power consumption his cost calculations showed an enormous potential for savings. Even the often costly and time consuming replacement of bulbs is dispensed with for LEDs. [...]



Werner Markenstein spoke on LED technology for underwater lighting.

Extract from BäderBau public & hotel 01/2011:



Flamingo Spa, Vantaa (Finland)

Hugo Lahme: Not only shining more beautifully

With a range of innovative LED underwater spotlights from the VitaLight series, Hugo Lahme GmbH offers high efficiency, quality and durability. The VitaLight POWER LED spotlights equate in their performance to halogen spotlights, but need approximately 80% less energy. Thus the enjoyment of bathing is not only nice, but also safe and efficient. Further information: www.lahme.de

Hugo Lahme in the press

Extract from EuroAmusement Professional 1/2011:

LED – more than just a trend

That high quality underwater lighting can also be efficient was demonstrated by *Hugo Lahme GmbH* one again at the last "interbad". The LED underwater spotlights from the „VitaLight[®]“ series offer the customer efficiency, quality and longevity explained Director *Werner Markenstein*. So with the VitaLight[®] POWER LED spotlights not only impressive lighting can be realised, but also the costs of energy and maintenance are minimised effectively. In order to get away from the sterile appearance which most halogen lamps give, the *Fläming-Therme Luckenwalde* for example, has been changed to LEDs almost completely. The target of not only saving a lot of energy but also to be able to provide creatively coloured light has succeeded well, says Markenstein. Whilst the use of white light can underline clarity particularly in sports pools, the coloured LEDs are suitable primarily for design in the wellness area.

The VitaLight[®] POWER LED spotlights equate in their performance to halogen spotlights, but need approximately 80% less energy. So they pay for themselves in a very short time. If one compares the substantially longer life of VitaLight[®] POWER LED spotlights of approx. 50,000 hours (9 h./day x 320 days/year = 17 years!) with no replacing of light bulbs including the substantially lower electricity consumption with the costs of conventional PAR or halogen spotlights, it very quickly becomes clear that LED technology promises an enormous potential for savings. (ALK)



Werner Markenstein, Director at Hugo Lahme, is convinced of the potential of the new VitaLight[®] POWER LED spotlights.

Hugo Lahme in the press

Extract from AB Archiv des Badewesens 8/2009:

Light, safety and efficiency - VitaLight[®]-POWER-LED

Hugo Lahme GmbH of Ennepetal offers with its POWER LED spotlights high intensity lighting in the colours white, blue and RGB (colour change red, green, blue) for public baths. These are energy-efficient, have a long life and are the only ones to meet all European safety standards. The performance of the LED spotlight is convincing with up to 24 x 3 W and a light yield of 90 Lumen/W.

In this way the performance of a VitaLight[®] 24 x 3 W POWER LED equates to that of a 400 W halogen spotlight using 80 % less energy. The spotlights made of gun metal or bronze and stainless steel have a long life expectancy of 50,000

hours and have a 4 mm thick safety glass pane. They can be installed easily in all swimming pools using the 5 m silicone cable included.

For a lower lighting requirement LED spotlights with a performance of 12 x 3 W or 4 x 3 W are available. All LED spotlights are compatible with each other and can be controlled by DMX, radio or button. As well as protection class III IP 68, all VitaLight[®] LED spotlights the only ones to meet all European safety tests and standards.

These include:

- Low Voltage Directive (EN 61 347-2-13),
- Filament lamps standard (EN 61 047),
- Radio disturbance standard (EN 55 015),
- EMC immunity requirements (EN 61 547:1955),
- Line current - ripple current standard (EN 61 000-3-2),
- Voltage fluctuations and flicker standard (EN 61 000-3-3),
- Laser class I (EN 60 825-1),
- DALI Standard (IEC 62 386-207) and
- VDE and CE Conformity



Hugo Lahme in the press

Extract from *Schwimmbad und Sauna PROFI* 7/8 2008:

PROFI

REPORT "LED-SEMINAR HUGO LAHME GMBH"

Welcome to
Hugo Lahme GmbH
VitaLight® LED-Seminar
9th October 2008



Background knowledge on the trend

In order to provide practical information on the latest developments in LED technology, Hugo Lahme GmbH invited dealers from Germany, Austria, Switzerland and the Netherlands to its headquarters for a specialist seminar at the beginning of October.

All experts agree on one point: The subject of light is becoming more and more important in the planning and design of pools and wellness facilities. Not only, but mostly on account of the rapid development of LED technology in this area. For this reason the technical specialist for swimming pools, the long-established Hugo Lahme GmbH, with its VitaLight® brand one of the most successful suppliers of lights for above and below water, organised a one-day seminar at the beginning of October for its trading partners in the company headquarters in Ennepetal. And

appears to have scored a bullseye, despite the flood of events in the hot autumn exhibition period. The meeting room was certainly well filled; practically all reputable wholesalers used the chance to obtain information at first hand. On the sidelines of the course, participants also discussed vividly and profoundly with the experts present - a clear indicator of the great interest of the dealers in this trend.

The aim of the LED seminar: To explain the current position of the technology in a practical way and to impart that background



Answered the many questions of the customers at the LED seminar:
Hans-Joachim Wittwer, Director of Hugo Lahme GmbH.



Provided detailed insights into LED technology:
The light expert Rudolf Schmitz, Director of Lahme-development partner Scemtec.

knowledge for the evaluation of the products on the market. "Of course, we also wanted to demonstrate how innovative and energy-saving our LED spotlights are" explained Hans-Joachim Wittwer, Director of Hugo Lahme GmbH, on greeting the participants from Germany, Austria, Switzerland and the Netherlands. After an extensive tour of the plant the light expert Rudolf Schmitz, Director of Lahme - development partner Scemtec GmbH, took over. He explained to the participants in two blocks of lectures in a detailed and knowledgeable way how LED spotlights work and on the special requirements to be observed in the installation and retrofitting. In addition he presented the newest products of the LED sector, jointly developed by Hugo Lahme and Scemtec. And referred in this context to an important feature: All boards of the VitaLight[®] spotlights are coated with a special protecting paint and in this way are particularly well protected against damp. Above all, Rudolf Schmitz highlighted three core advantages of LED technology: the lights are bright, durable and energy efficient. But only if the manufacturer skilfully exploits the potential of the technology.

"The aim of our development is always powerful lighting products with minimal energy consumption" was how Schmitz defined the company philosophy. And in doing so did away with many a myth. For example, the number of watts on its own says very little about the power of an LED spotlight. The only crucial factor is what power is produced. Very important for the intensity of the light is, for example, the quality of the lens used which bundles the light together and distributes it according to



requirements. "Bad lenses swallow in extreme cases up to half of the impinging light" reported the expert from his many years of experience.

To conclude the successful event Werner Markenstein, Manager of Hugo Lahme GmbH, calculated the savings potential of the VitaLight[®] LED spotlights compared to conventional halogen spotlights. The result: After only a few years the additional cost had amortised itself.

Conclusion of the event: In the future there is no way around LED technology - be it in new construction or redevelopment.

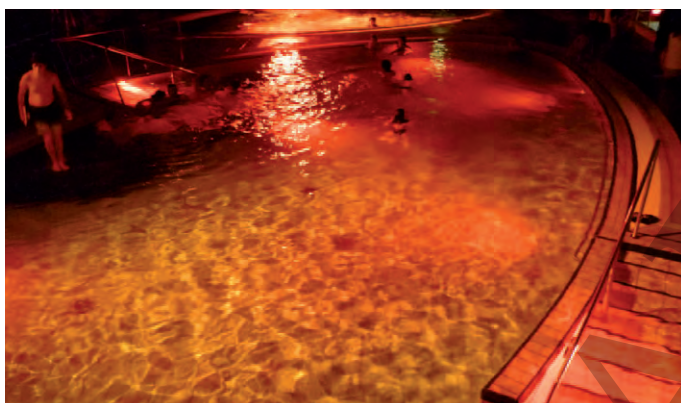
References



Splash! Sauna- und Badeland, Kürten (Germany)



Splash! Sauna- und Badeland, Kürten (Germany)



Fackelmann Therme, Hersbruck (Germany)



Fackelmann Therme, Hersbruck (Germany)



AQUApark, Oberhausen (Germany)



AQUApark, Oberhausen (Germany)



SaarowTherme, Bad Saarow (Germany)



SaarowTherme, Bad Saarow (Germany)

References



Maximare Erlebnistherme, Hamm (Deutschland)



Maximare Erlebnistherme, Hamm (Deutschland)



Flamingo Spa, Vantaa (Finland)



Flamingo Spa, Vantaa (Finland)



Green Village, Lignano (Italy)



Green Village Lignano (Italy)



SHA Wellness Clinic, Alicante (Spain)



SHA Wellness Clinic, Alicante (Spain)