watercube

↓

Elements of lighting

01

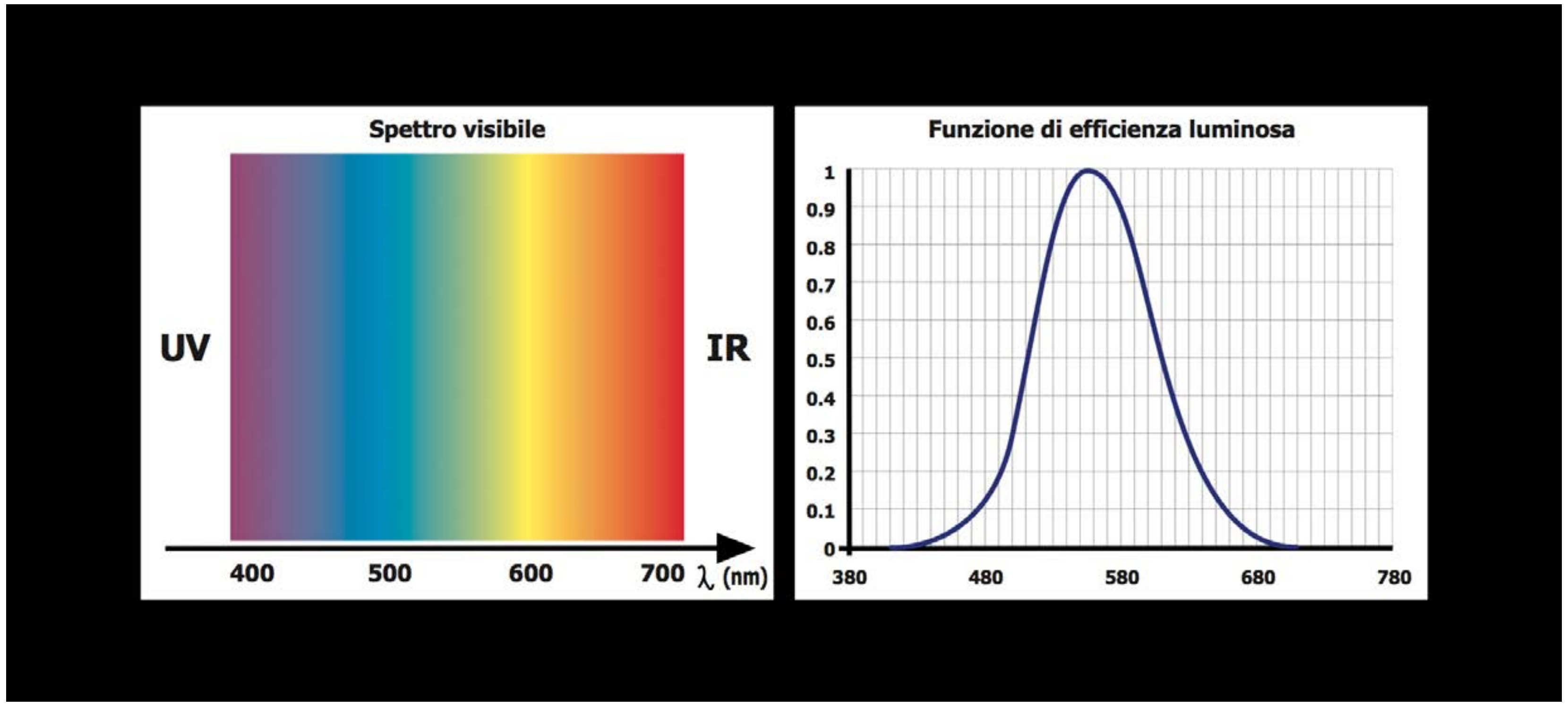
Unit of misure

Watt

Symbol: [W] this is an International unit of measure for power.
It is the equivalent of 1 joule per second or, in electric units, 1 volt-ampere.

Lumen

Its abbreviation is [Im] and it is the unit of measure for light flow. It is the equivalent of light flow obtained from a solid angle of 1 steradian emitted in all directions from a source with an intensity of light of 1 candle.



Luminous Efficacy

The luminous efficacy of a light source is the ratio of luminous flow emitted from a light source [Im] to the electric power [w] consumed by this source (expressed in [LPW]), and thus describes how well the source provides visible light from a given lamp. Luminous flow is defined based on the subjective perception of the average human eye and corresponds to a particular curve in the spectrum of visible light. A lamp produces radiation even out of the visible band, in general in infrared and ultraviolet, which does not contribute to the sensation of luminosity. The luminous efficacy of a lamp depends on how much of a spectrum adapted to human perception it produces.

01

Unit of misure

Tipo spettrale	Temperatura gradi Kelvin	Colore	Composizione chimica
0	Oltre 50000	Azzurro	Elio ionizzato, elio
B	25000	Azzurro bianco	Elio ionizzato e neutro ossigeno ionizzato
A	20000	Bianco	Idrogeno
F	14600	Bianco giallo	Idrogeno in diminuzione e calcio ionizzato
G	6000	Giallo	Ferro oltre a calcio
K	5100	Arancione	I metalli superano l'idrogeno calcio ionizzato e neutro biossido di titanio
M	3600	Rosso	Calcio neutro e biossido di titanio

Colour temperature

Another element of a lamp is the colour of the light produced, which can be hot or cold. This parameter is usually called colour temperature that is the shade of colour of the light emitted by a blackbody heated at the given temperature. This value is expressed in Kelvin. When speaking of hot light, we are speaking about the red part of the spectrum and thus emitted from a cooler body.
As the temperature rises the light gradually passes from red to orange to yellow to white and at the end blue-white. As the temperature rises the whiteness rises.

Light colour

The colour prevailing from emitted light is called light colour.
If the colour prevailing from the light tends to be red the emitted light has a warm colour; if the colour prevailing from the light tends to be blue it has a cool colour.
Normally the colour of the light is expressed in Kelvin, just like the colour temperature. Low levels of colour temperature (1800 °K) correspond to warm colours (red), high level of colour temperature (up to 15000 °K) correspond to cool colours (blue).

02

Lighting

Basic principals of incandescent light

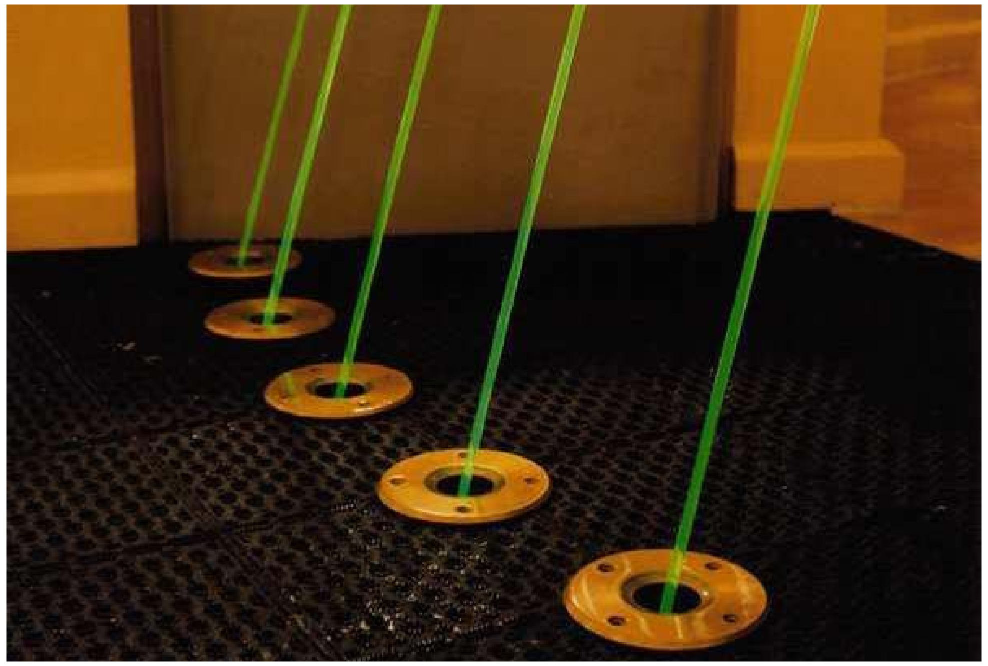
The incandescent light bulb is a source of light produced by heating (up to approx. 2700° K) the tungsten filament through which the electric current passes. The energy given is transformed into light and heat.
The Tungsten filament has the characteristics of increasing its electric resistance to increase the temperature and thus give incandescent light.
With some technical solutions, adjustments and developments this type of light is still in use, and has been in use for more than one hundred years.
The external glass bulb keeps the filament vacuum-sealed so that it does not burn when in contact with the oxygen present in the air. Presently, suitable gases are used to increase the life span of the filament.
Unfortunately incandescent light is not energy efficient since the majority of the energy is converted into heat.

Halogen lamp lighting

Halogen lamps are an evolution of the functioning principle of incandescent lamps. In traditional halogen lamps the tungsten filament wears out with use; the "wear" particles are deposited in the inner part of the bulb and consequently dimming and reducing the light of the lamp. With the passing of time, the filament wears out to a point that the thinning causes the filament to break and consequently the lamp breaks.
The introduction of halogen gas inside the bulb makes the tungsten, which has detached because of wear and tear of the filament, re-deposit on the filament. This makes for a slower deterioration of the filament, and thus improving the duration of the lamp, better energy efficiency and a better light quality.
Halogen lamps have a greater working temperature compared to standard incandescent lamps and the light produced has a bluer and greener colour: therefore the light produced by a halogen lamp appears whiter and brighter.

02

Lighting



Fibre Optic: a high impact and better quality alternative to lighting fountains

Today light (even natural light) can be transported through appropriate channels. These channels can either be optic conducts, using thin strings or fibres made of glass or plastic.
In optical fibres systems the lighter is the heart of the system: it generates light and sends it to the optical fibre (minimizing any type of dispersion). It is made up of the following elements:

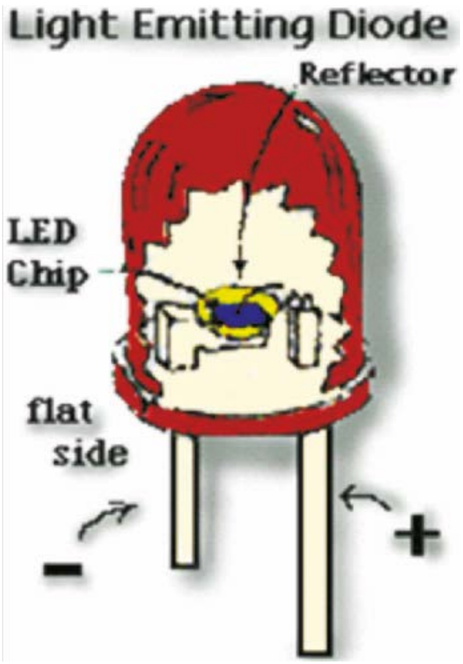
- Halogen or metallic iodide lamps, according to the type of lighter;
- Anti-UV and IR filter;
- Silenced ventilator;
- Transformer;
- Electric lighting system for the metallic iodide version.

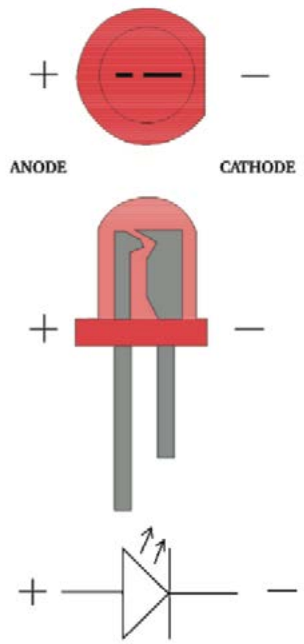
Each conduct is made up of a small beam of thin filaments (sheathed in PVC or other protective flame and fire proof materials), or fibres that are less than one diameter in order to assure flexibility.
The main advantages offered by these lighting systems come from the prerequisite of the transportation of light. Only light radiation runs through the optic conducts, electric power or heat is not present. Using small cables, it is possible to bring considerable quantities of light into small spaces and in places where it would be difficult, if not impossible, to light with traditional devices. Some examples of these are; in water, in the midst of easily flammable materials or materials that can be altered because of thermal energy.
Optical fibres create light installations such as starry skies, animated figures, letters, words, logos, as well as optic guides that are used in places where children, elderly and disabled people are present.
A problem that arises with the use of optical fibres is the loss of luminosity during transmission.
The loss of luminosity depends on the length of the route of the light.
Fountain designers that use optical fibres lighting must always pay careful attention to where they place the light, and the following must be kept in mind:

- There should be a maximum distance of approximately 8-10 meters per application
- The application must be invisible
- The application must be placed in a system protected from water.
- The application must be protected from vandalism

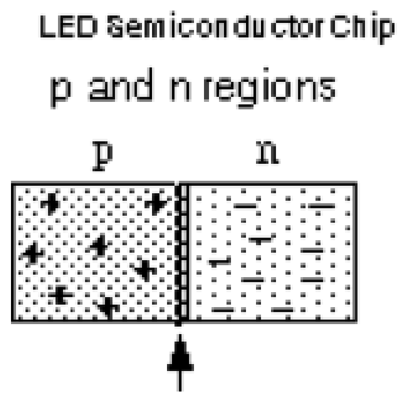
03

Basic principles of the functioning of LED





LED stands for Light Emitting Diode.



The chip of the LED is a semiconductor that is created in two distinct areas: the positive "p" and the negative "n", which are separated by a junction.
Each LED is no larger than the tip of a pencil and so they are used in groups of at least one hundred.
LEDs are like small bulbs that produce light and are applied to electric circuits. Contrary to incandescent lamps, they do not have a filament that could burn and they do not generate heat.
The movement of electrons in semi-conductor materials lights the LEDs and they have a long life span similar to a normal transistor.

The main part of the light bodies of a LED is the semi-conductor part (the central part of the bulb) called a "chip".
The chip has two regions that are separated by a junction. The "p" region is positively charged and the "n" region is negatively charged.
The purpose of the junction is to stop the migration of the electrons between the two regions, "p" and "n", up to a determined value of applied voltage.
Only when the difference of applied voltage exceeds certain values does the junction of the semi-conductor allow the flow of electrons to the "p" region.
The three components for the difference of colour of LEDs are: Light, animation control, information input.
Combination of red, green and blue colouring, to get different LED colours (RGB system).
LEDs of different colour can be obtained by combining green, red and blue. By changing the proportions of the different colours (0-100%), all the colours of the colour spectrum can be produced.
Typical applications are computer and television screens. The maximum number of colours in the different shades that can be produced are around 16 million.

04 Characteristics of LEDs

These recently developed light systems are made up of one or more LED diodes that are powered by an electronic circuit. They are white lights with a low level of heat. They are smaller light sources, with great productivity, with a functioning duration ranging from10,000 to 100,000 hours depending on the type of LEDs and the colours, and thus eliminating the need for frequent light bulb changes. This technology is applied to light systems and decorations that are enclosed in flooring-walls-ceilings both indoors and outdoors; light strips for internal design, tubes, colour changes, any type of light composition is possible and this gives vent to creativity and makes it possible to produce fantastic effects, which were once technically impossible. Using unique devices it is possible to uniformly or intermittently change colours, mix colours to create new nuances, adjust the speed of the colour change, and create moving effects.

The first LED was invented in 1960 for simple applications with weak emission of red lights. Currently the applications are numerous, the colours are different and the light intensity is enhanced. They are produced with the use of semi-conductors that directly convert electric current into light. LED modules give a lot of creative possibility to design and innovation thanks to the varieties of colours, their compactness, and flexibility.

The efficiency of LEDs has remarkably improved in the last few years and has reached levels superior to 20 lm/W, depending on the colour.

The direct voltage depends on the colour of the light and goes from 2 to 4V, with a current that cannot surpass 700 mA.

The maximum luminosity is obtained with a constant feed of electric current.

04 Characteristics of LEDs

Adjustment of the LED

The controlling of each channel, with the same colour, to which the LEDs are connected allows for a variety of shades based on different intensities of red, green and blue.
The adjustment of the flow of each colour is given through the use of specific dimmers. Basically, these accessories turn the LEDs on and off with a constant frequency and a variable period of lighting (the slowness of the human eye makes the lighting seem integrated and thus gives the impression of adjustment).

Technological advantages

- Reduced electric energy consumption
- High chromatic efficiency
- Extremely long duration (at the end of the life span they slowly wear out).
- Reduced dimensions
- High resistance to knocks an vibrations
- Direct light emission
- No emissions of infrared/ultraviolet rays
- Reduced power absorption
- Minimum heat generation
- Immediate lighting,
- Precise controlling of the beam and minimum glare;
- Easy to install, light, and need a small amount of maintenance

An unfavourable note: they are expensive.

Application of the LEDs

In the past, LEDs were not suitable for the lighting of open areas. Today, high intensity LEDS can be used in water even in the presence of a foamy effect.

Multi-tap transformer (variable value voltage output)

Multi-tap transformer (variable value voltage output)
These transformers can have different voltage values in secondary output circuits such as 13 and 14 [V].
In a specific case, where a 12 [V] lamp is fed with a lower voltage, for reasons connected to the loss in the line, if there is the possibility to change the output voltage to a secondary output increasing it to 14 [V] we would obtain a correct value in the lamp.

05

Solution for the placing of lights

Luci wet/dry (luci sopra o sotto acqua)

- Reduced electric energy consumption
- High chromatic efficiency
- Extremely long duration (at the end of the life span they slowly wear out).
- Reduced dimensions
- High resistance to knocks and vibrations
- Direct light emission
- No emissions of infrared/ultraviolet rays
- Reduced power absorption
- Minimum heat generation
- Immediate lighting,
- Precise controlling of the beam and minimum glare;
- Easy to install, light, and need a small amount of maintenance
- An unfavourable note: they are expensive.

Basic components for fountain lights

- The lights also comprise a part which contains the light itself.
- The lights have standard components.

→ Elements of lighting

06

Example of positioning of the lights

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Example of lights placed to the side of the jet

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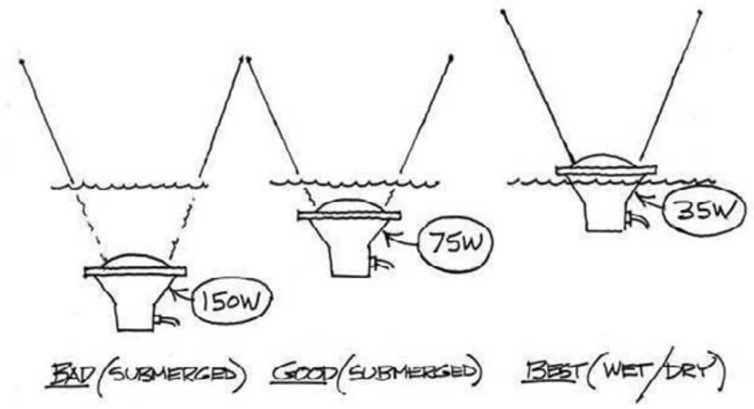
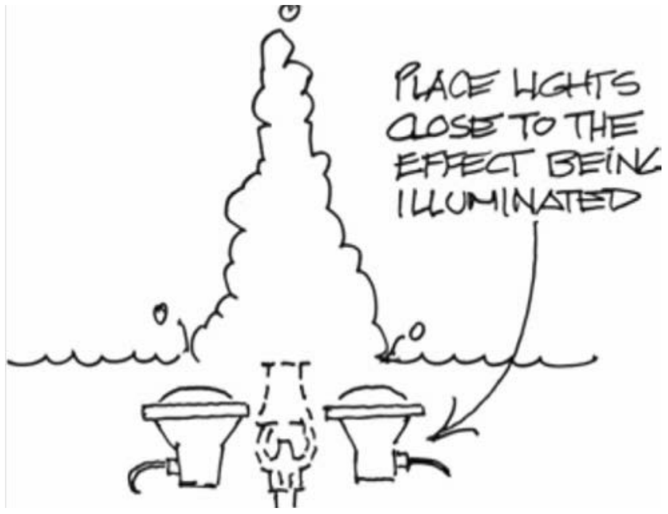
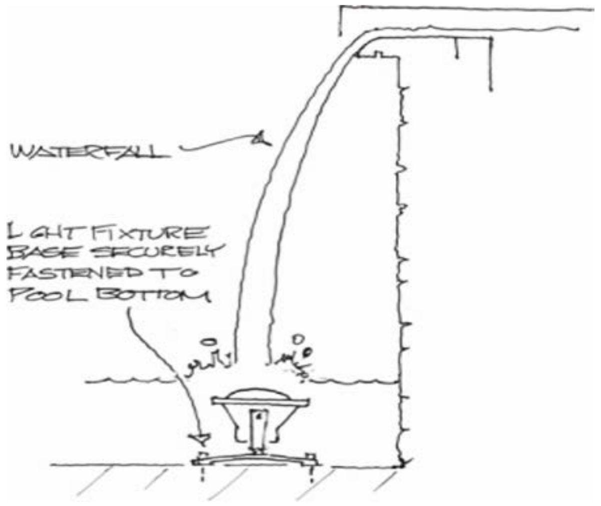
Suitably fixing the bodies to the flooring helps stabilize the light flow even in cases where the light is positioned under a waterfall







06

Example of positioning of the lights

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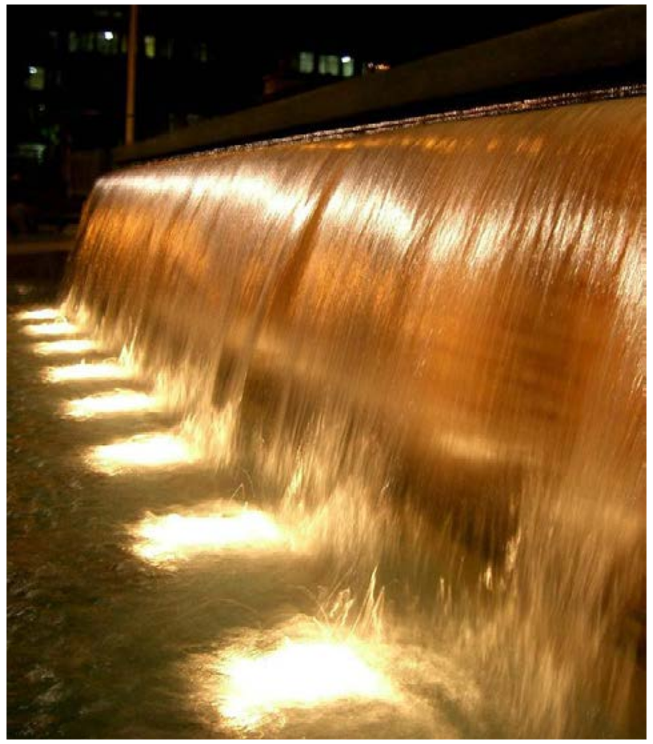
Underwater lighting and jet



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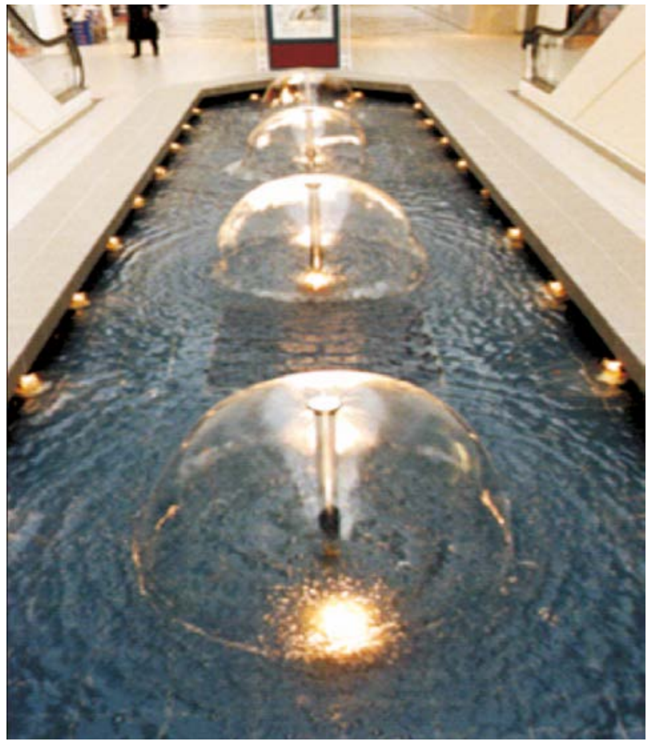
Lighting under the water blade



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Wall installation

06

Example of positioning of the lights

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The use of lights under water enhances the surrounding architectural elements

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The use of lights under water reflects the lights in the surrounding materials

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Some water effects need other light sources to help the lighting in the architectural parts above

06

Example of positioning of the lights

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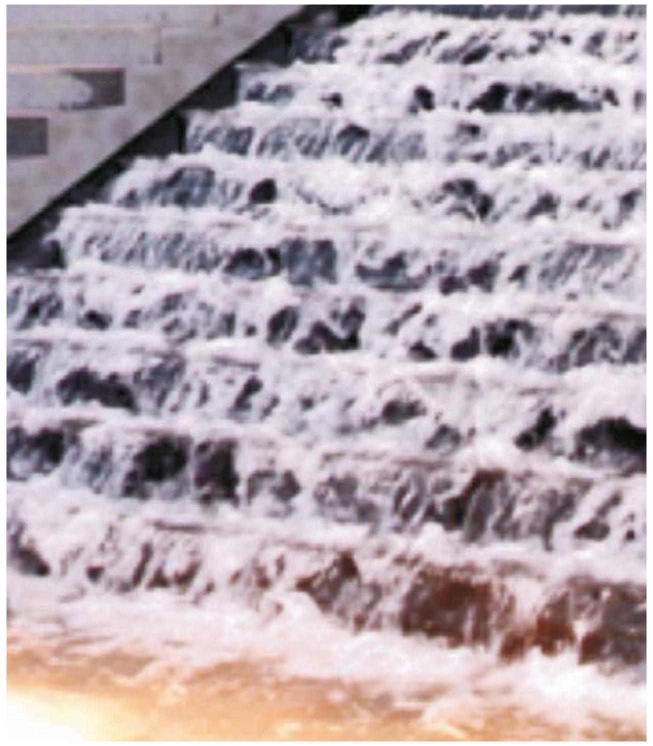
Lighting from above



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The submerged lights could be ineffective in lighting the different layers of the waterfall.

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Imposing water works need a lot of lights for each jet

The submerged lights will light the final part of the water that comes from the upper part that is not lighted and enters into the catch basin.
Applications with open water effects need more lighting.
Water effects with clear jets guarantee an easy light reflection. Less lighting is needed.

➔ Elements of lighting

This document was drawn up to supply an overview and a general aid to fountain designers. Our technicians are available to answer any further question you may have and help you realize a properly functioning fountain.

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