

# Compact knowledge of flash photography



 **broncolor**  
*lighting school*

# Introduction

This e-book was developed by broncolor to provide anyone interested in lighting – photographers, students, educators, and all curious minds – with a solid understanding of flash photography.

As a manufacturer of professional lighting systems, it is important to us to share knowledge, offer orientation, and support users in their daily creative work.

We have compiled the most essential foundations, terms, and technical principles in a compact, clear, and visually illustrated format. The goal is to offer a structured and accessible introduction to the world of flash light – from physical fundamentals and light characteristics to practical flash-related terminology.

We wish you inspiration, clarity, and enjoyment as you learn, explore, and apply this knowledge.

**Your broncolor Team**

December 2025

# Content

<b>Why use flash</b> - advantages of flash over available light	04	12. Flash sync time	33
<b>Principle and terms of lighting</b>		13. Flash triggering	34
1. Illumination	08	14. Flash scattering/diffusion	36
2. Penumbra and umbra	12	15. Flash correction	37
3. Edge gradient	16	16. Direct/Indirect flash	38
4. Shadow sharpness/Shadow definition	20	17. High Speed Sync (HSS)	39
5. Shadow depth and scattered light	24	18. Strobe flash	40
6. Highlights/Spots	26	19. Alternate	41
7. White balance	27	20. Delay	42
8. Colour temperature	28	21. Sequence	42
9. Colour consistency	29	22. Interval	42
<b>Flash photography terms</b>		<b>The light</b>	
10. Joules and watt-seconds	31	23. Hard light	45
11. Flash duration	32	24. Soft light	47
		25. Diffuse light	49

## Why use flash – advantages of flash over available light

Flash is independent of the time of day and the weather. It provides a constant light source that is available at all times and allows for consistent results.

With flash, the photographer has full control over the brightness, colour consistency, white balance and direction of the light.

By using light shapers, e.g. reflectors, illumination can be created perfectly for the respective motif. The design of shadows and contrasts, with the help of soft and hard light, helps to make the motifs look more plastic and interesting.

Even on-location or outdoor photography can be enhanced by flash and used as illumination or as mood lighting.

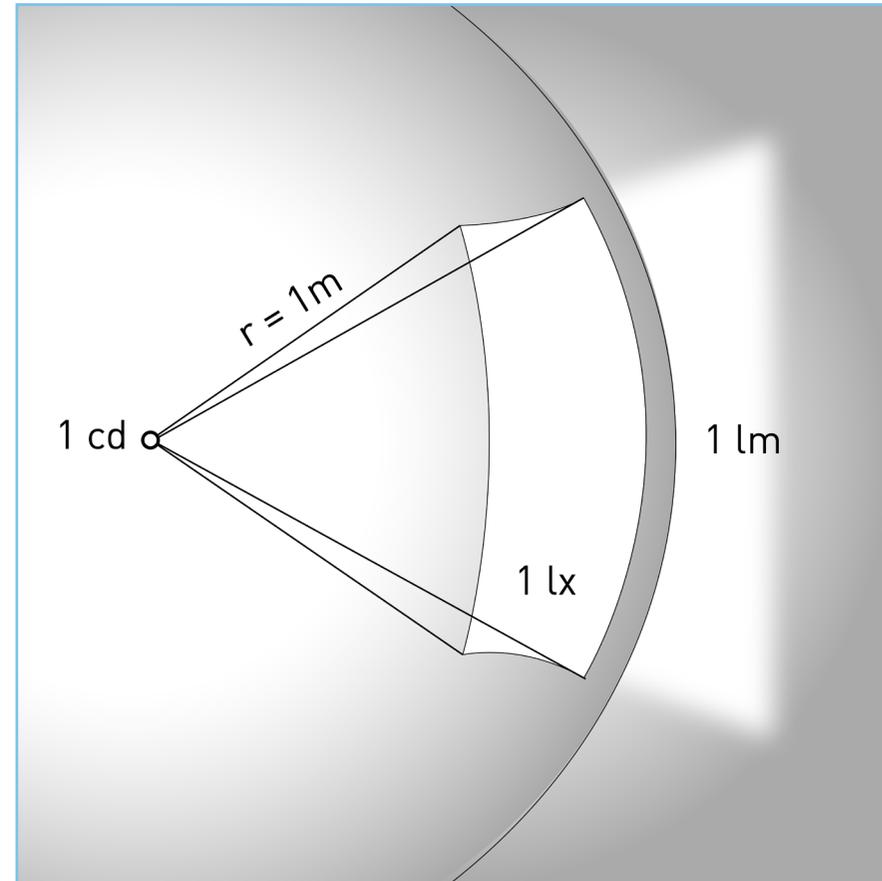
# I. Principle and terms of lighting

1. Illumination	08
2. Penumbra and umbra	09
3. Edge gradient	10
4. Shadow sharpness/Shadow definition	11
5. Shadow depth and scattered light	12
6. Highlights/Spots	13
7. White balance	14
8. Colour temperature	15
9. Colour consistency	16

# I. Principle and terms of lighting

A point light source emits light beams in a spherical shape. Let's imagine that it is located in the centre of a hollow sphere with a radius of  $r = 1$  m. A window of 1 m is cut out of the hollow sphere.

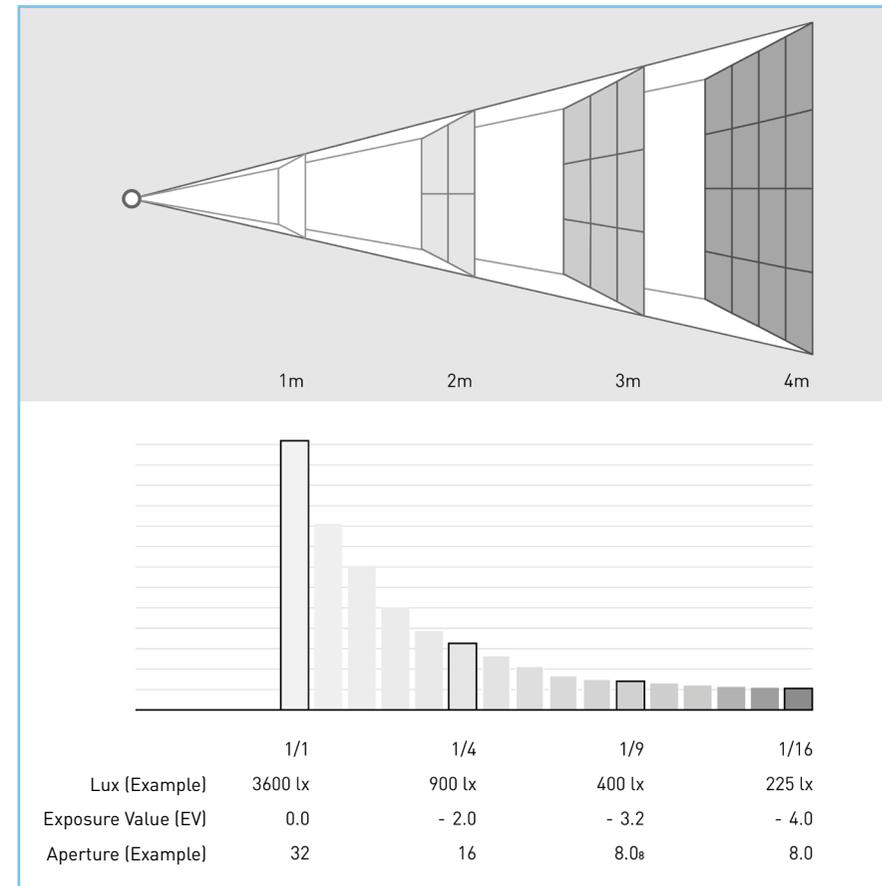
If the light source has a luminous intensity of 1 cd (candela), a luminous flux of 1 lm (lumen) is sent through the window. This corresponds to the 12.57th part of the total luminous flux (spherical surface =  $4 \cdot \pi \cdot r^2 = 12.57$  m<sup>2</sup>).



# I. Principle and terms of lighting

At a distance of 1 m (i.e. on the inside of the sphere and 'in the window'), there is an illuminance of 1 lx (Lux).

The illuminance increases or decreases in the square of the distance change. The illuminated areas are proportional to the squares of the distance.



# 1. Illumination

Illumination defines the type of illumination of the object when the light is directed directly at it. The illumination can be completely uniform (homogeneous), it can show a gradation (gradual), be centre-weighted or have a hot spot.

## **Focused and defocused position in light shapers**

The ability to switch between focused and defocused positions with professional luminaires gives photographers creative control over the lighting effect in their images.

The focused position is suitable for dramatic light accents and high contrasts, while the defocused position allows uniform illumination, which is ideal for portraits or atmospheric shots.

Professional luminaires provide adjustment mechanisms for these changes, allowing photographers to quickly switch between different lighting scenarios and flexibly adjust the effect of the light.

In the focused position, the bulb is positioned in such a way that the light is more focused and aligned more intensely.

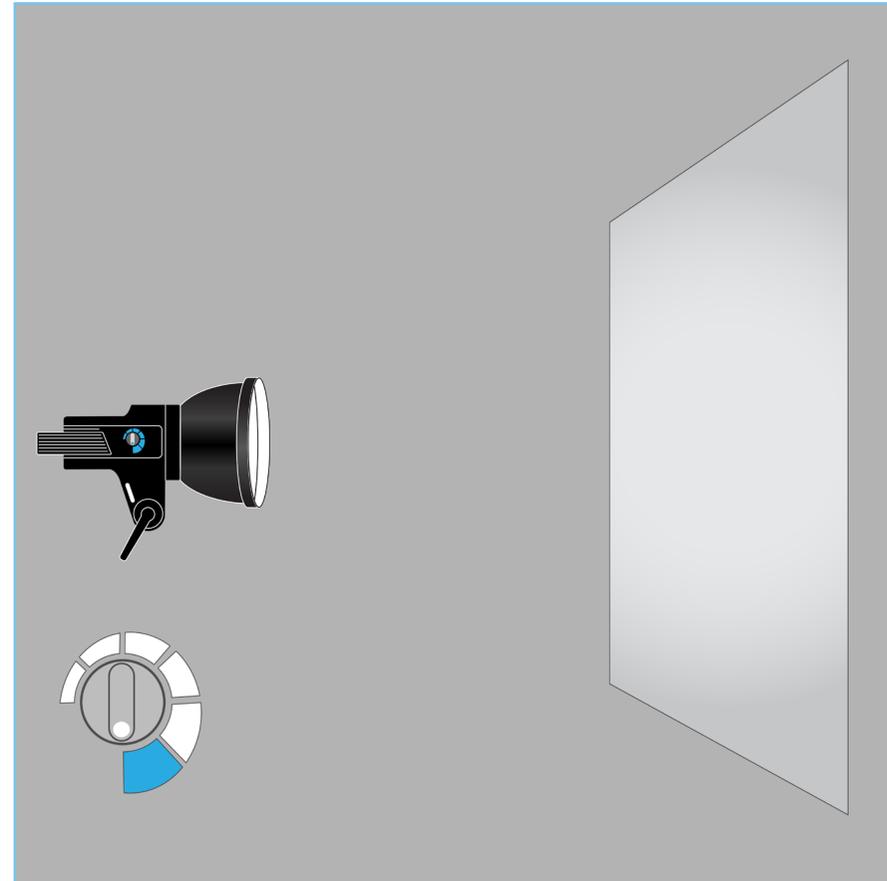
In the defocused position, the bulb is displaced in such a way that the light is scattered more widely and has a less intense effect.

# 1. Illumination

## 1.1. Illumination: Homogeneous

In the case of homogeneous illumination, we speak of uniform and balanced illumination of the entire image area. There are no strong contrasts between bright and dark areas, and all parts of the subject receive a similar light intensity.

Most reflectors produce a medium-emphasis illumination. Homogeneous illumination can be achieved with 'defocusable' luminaires. The angle of illumination increases in this position, and the light drop to the edge decreases. The intensity in the middle is of course lower compared to the 'focused' position, but the edge areas are comparatively brighter.



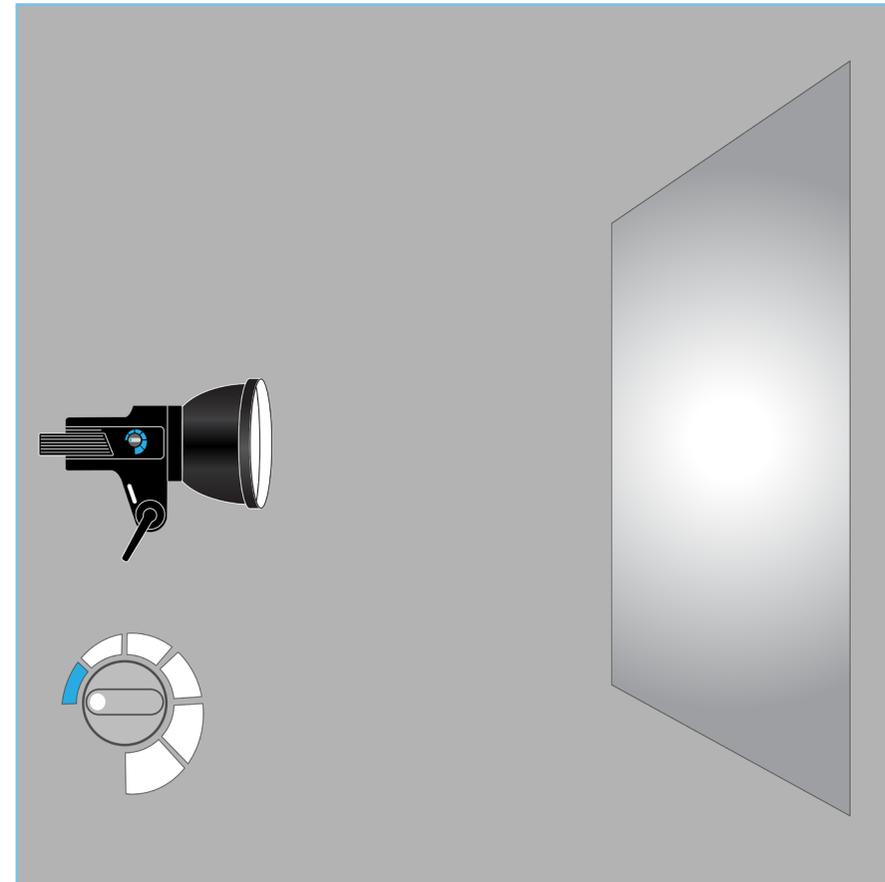
broncolor Pulso G, P70 standard reflector

# 1. Illumination

## 1.2. Illumination: Centre-weighted with 'hot spot'

Centre-weighted illumination is also referred to as a 'hot spot'. The difference between the brightness in the centre and the brightness at the edges depends greatly on the light shaper.

'Focused' position: The angle of illumination becomes smaller, and the light drop to the edge stronger. The intensity in the centre is significantly stronger compared to the 'defocused' position, but the edges are much darker.



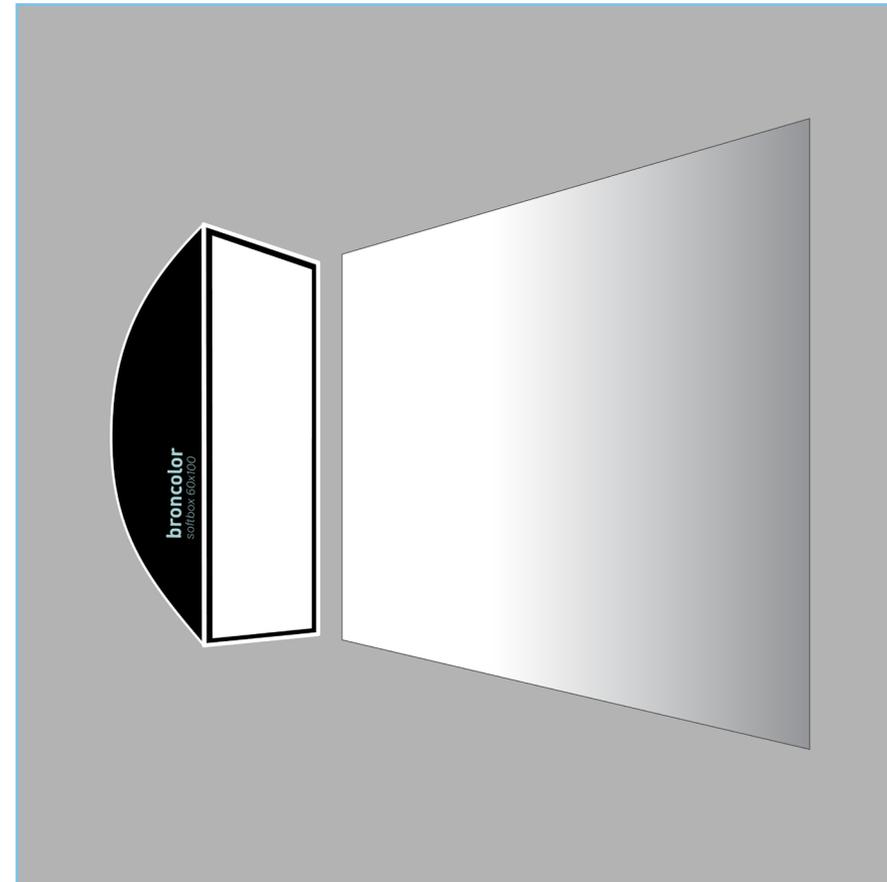
broncolor Pulso G, P70 standard reflector

# 1. Illumination

## 1.3. Illumination: Gradual

The illumination of a surface depends primarily on the angle of illumination. Due to the physically caused light drop, the area closest to the luminaire is illuminated much brighter than the opposite area.

In the case of (especially) elongated surface lights, this creates a linear profile. With a round illuminated surface, a radial course would accordingly be generated.



broncolor softbox 60 x 100 cm

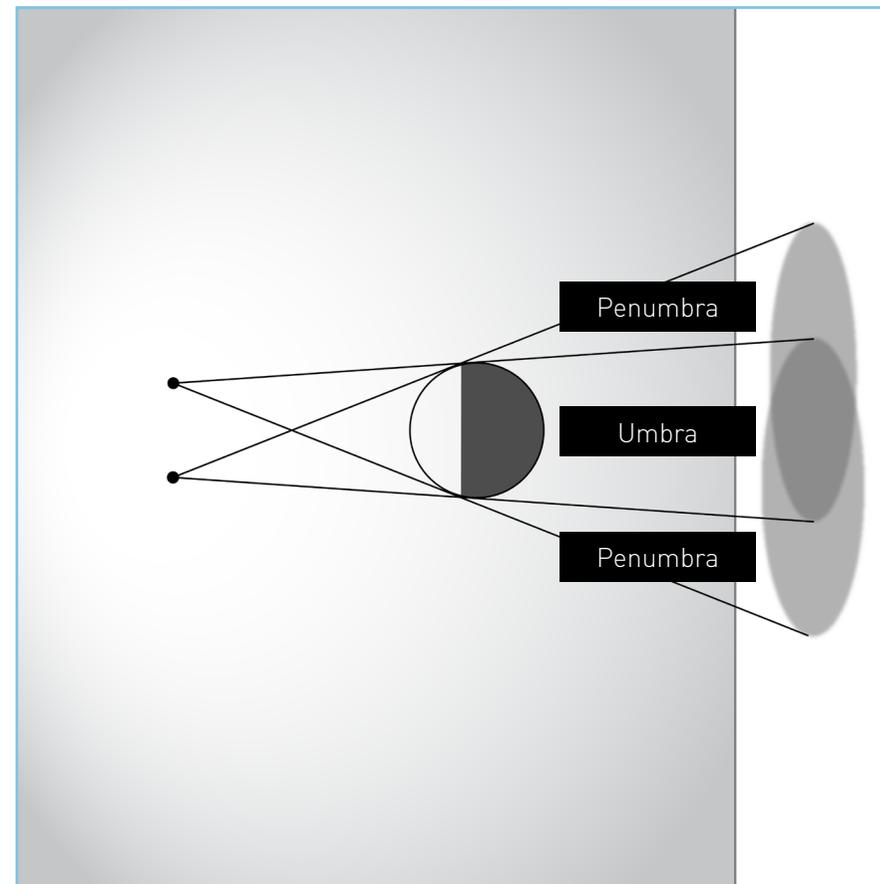
## 2. Penumbra and umbra

### 2.1. Two point light sources

Two point light sources illuminate the object. This creates two shifted shadows each. One point light brightens the shadow of the other. This creates two penumbras.

The area where no (direct) light rays reach is called the umbra.

Both penumbras, as well as the umbra, have clear, sharp contours.



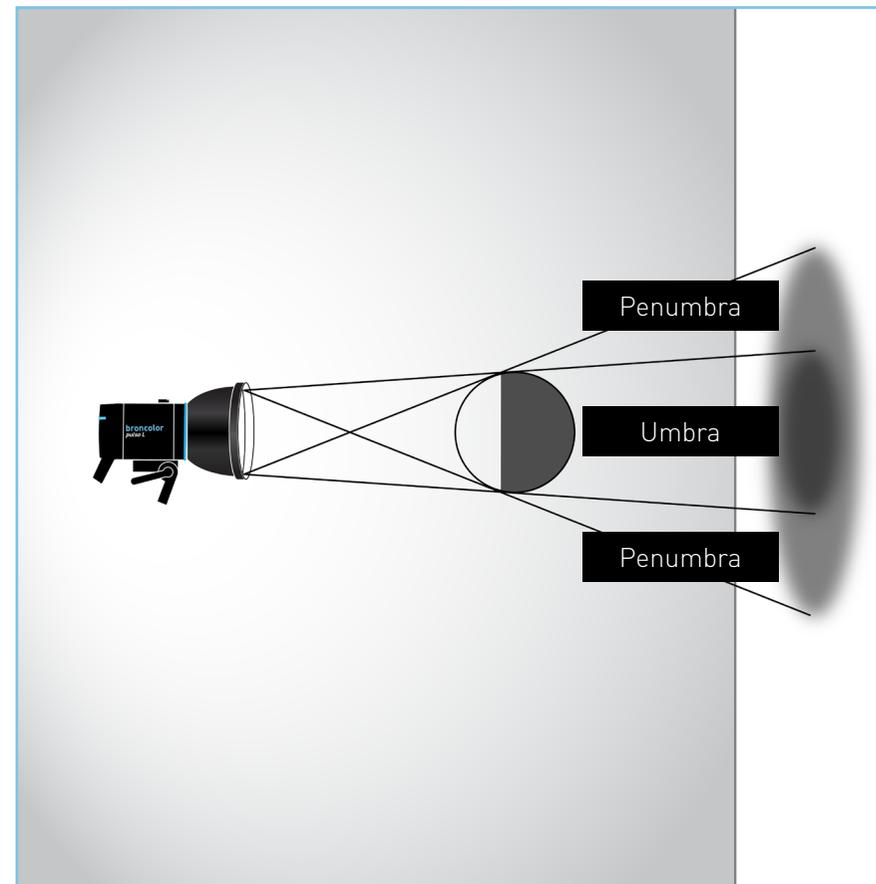
## 2. Penumbra and umbra

### 2.2. Light source: Reflector

A reflector directs all light beams in one direction. The beam path does not start from just one point. The diameter of the reflector forms a circular area.

From this surface, countless beams of light are sent forward at different angles.

The illustration shows only the rays that are responsible for the shadow: The umbra transitions smoothly into the ring-shaped penumbra. The contour of the shadow is yet to be determined.

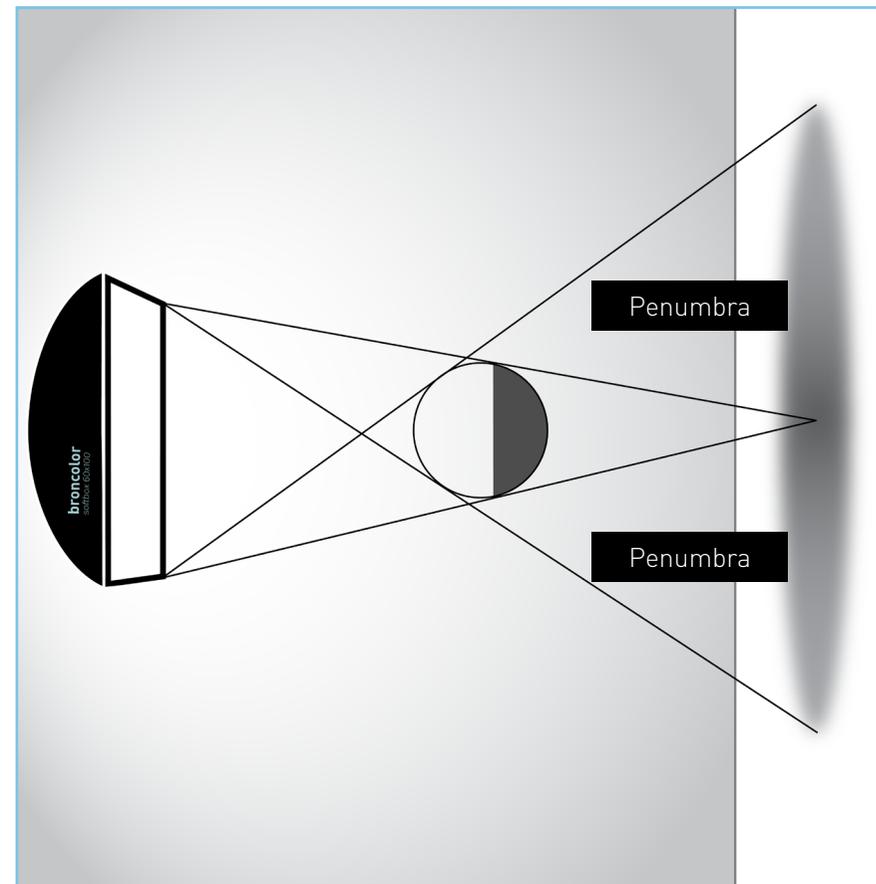


broncolor Pulso L, P70 standard reflector

## 2. Penumbra and umbra

### 2.3. Light source: Area light

A surface light creates a very soft shadow: The penumbra merges with the umbra. The contour of the shadow is hardly definable.



broncolor softbox 60 x 100 cm

## 2. Penumbra and umbra

### 2.4. Point light and shadow

2.4.1. Point light source close to the object

Object: Illumination only on a small area; large light drop within the illuminated area.

Shadow: Large shadow; much larger than the object.

Background: Illuminated area becomes significantly darker due to light drop.

Example: Candlelight

2.4.2. Point light source further away from the object

Illumination on a larger area; smaller light drop within illuminated area.

Shadow: Smaller shadow; larger than the object.

Background: Illuminated area becomes darker due to light drop.

Example: Simple light bulb in socket

2.4.3. Point light source infinitely far away

Object: Illumination on maximum area; practically no light drop within illuminated area.

Shadow: Same size as the object.

Background: Same illuminance as the object.

Example: Sun

### 3. Edge gradient

The edge profile determines the transition from the illuminated area to the unilluminated area.



## 3. Edge gradient

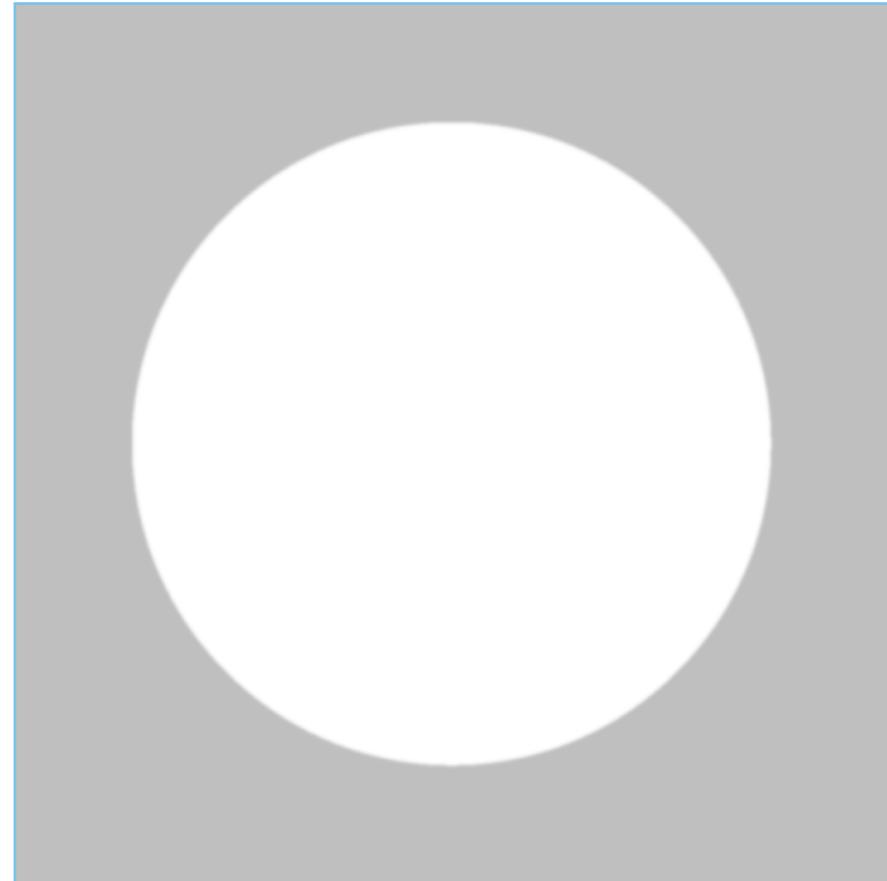
### 3.1. Edge gradient: sharp

Only projecting light shapers show a sharp edge: they depict the mask, template (gobo) or aperture used.

The lens system (or lens) used guarantees a 'clean' beam path. The illumination within the illuminated area is almost 100% homogeneous.

#### Example

Picolite, projection attachment



## 3. Edge gradient

### 3.2. Edge gradient: blurred

The edge of the illuminated area can be detected, but it is blurred. This is typical for all light farmers with a Fresnel lens: The light beams are bundled by lens-like systems. The illumination is usually homogeneous.

#### Example

Pulso L, flooter



## 3. Edge gradient

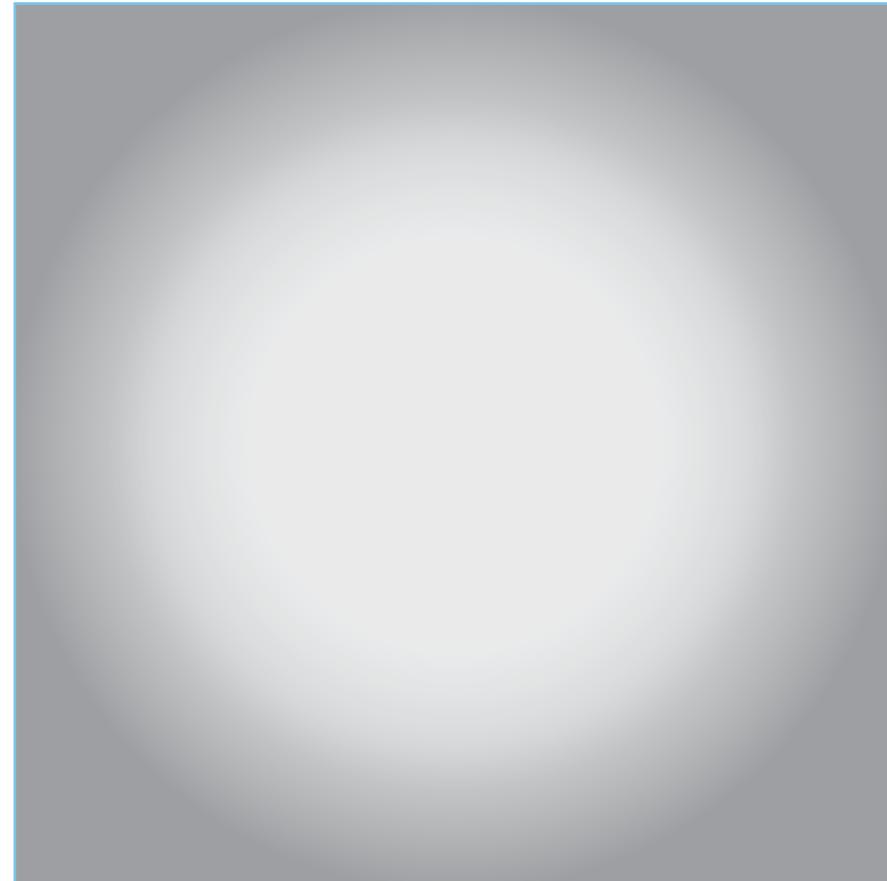
### 3.3. Edge gradient: gradient

The edge is barely perceptible as such. Rather, we see a course.

The marginal rays are significantly weaker and/or less numerous. Typical of this effect are light shapers with a honeycomb grid in front. The illumination within the cone is often already running.

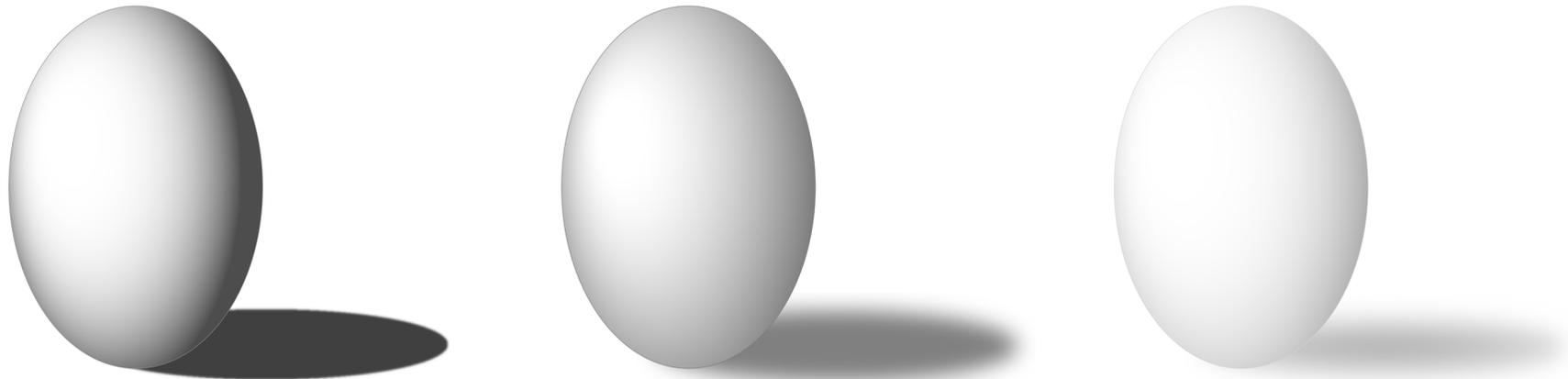
#### Example

Pulso L, P70 standard reflector, grid



## 4. Shadow sharpness/Shadow definition

This refers to the sharpness of the shadow. It also says something about the shape (rectangular or round) and the distance of the light shaper from the object.



## 4. Shadow sharpness/Shadow definition

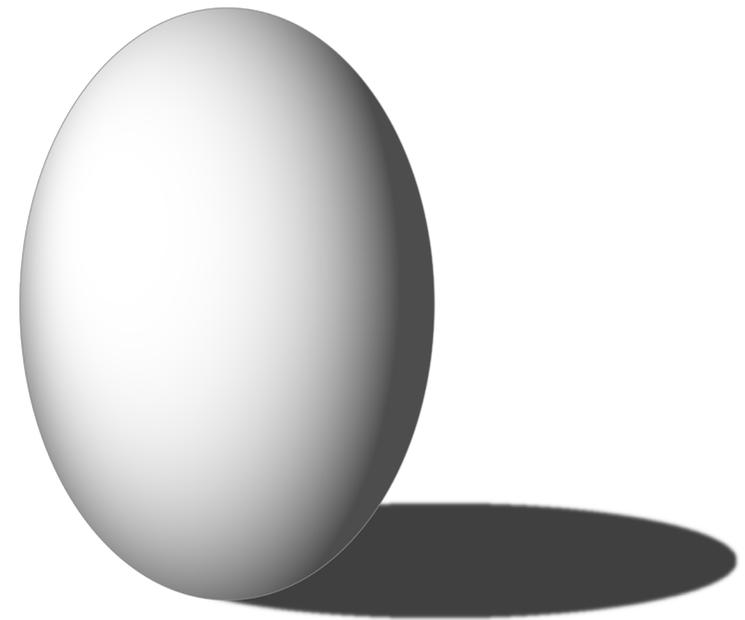
### 4.1. Shadow sharpness: sharp

The smaller the light source, the sharper the shadow (see penumbra/umbra). The greater the distance to the light source, the sharper the shadow.

Projecting light shapers (projection attachment) also produce very sharp shadows due to their strictly divergent beam.

#### Example

Picolite, projection attachment



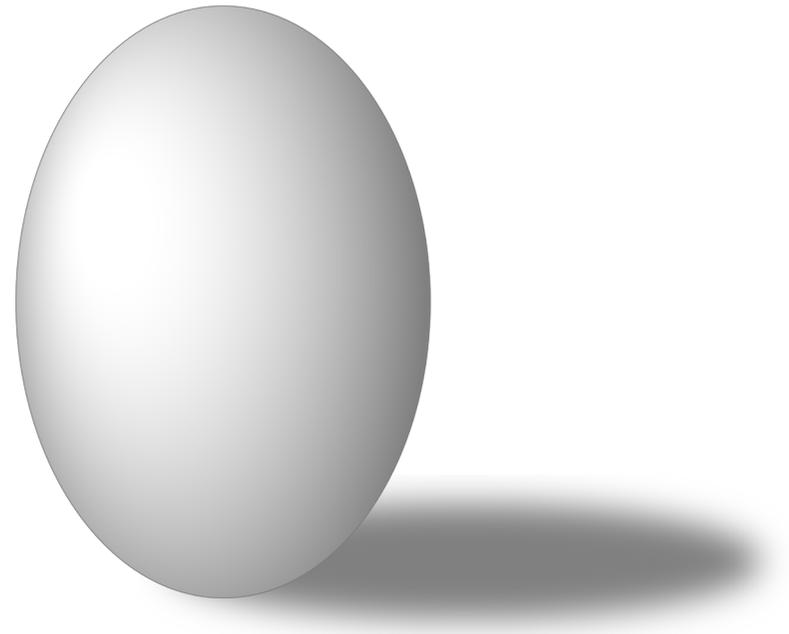
## 4. Shadow sharpness/Shadow definition

### 4.2. Shadow sharpness: blurred

The larger the light source, the blurrier the shadows.  
The closer the light source, the blurrier the shadows.  
Blurred shadows differ from diffuse shadows in that their outlines are blurred but still recognisable.  
The more convergent light rays the beam contains, the blurrier the shadow becomes. These arise, for example, on the surface of reflectors or through the focusing effect of stepped or Fresnel lenses.

#### Example

Stelos, octabox 75



## 4. Shadow sharpness/Shadow definition

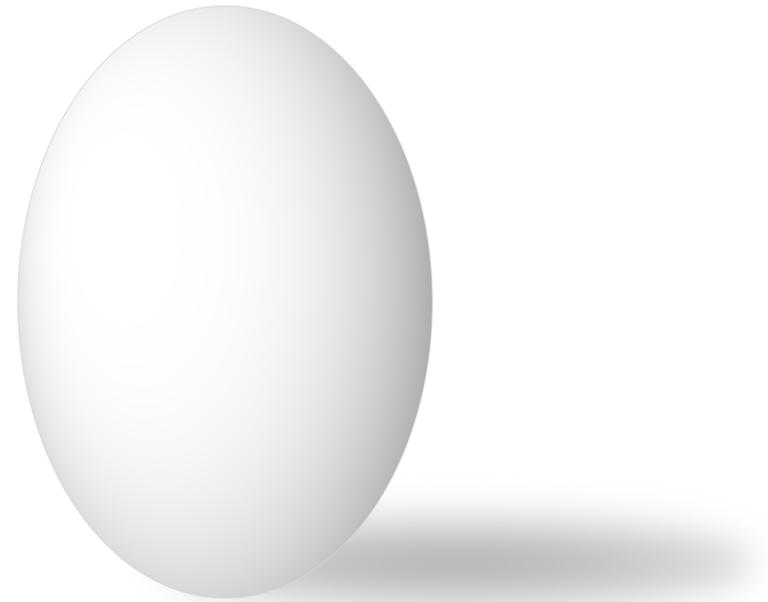
### 4.3. Shadow sharpness: diffused

Diffuse shadows barely reveal the outline of the object. They are created by surface luminaires that, due to their diffusers (plexiglass, fabric or foil), do not actually emit a beam of light. The light rays scatter in all directions.

However: If a surface light is positioned at a sufficient distance, it acts as a small(er) light source and can therefore create sharper edges.

### Example

broncolor balloon



## 5. Shadow depth and scattered light

The depth of shadow determines the density of the shadows from pure to barely perceptible black. While the shadow depth depends on the light shaper or the amount of scattered light, it is also dependent on the scattered light it generates and on the studio environment.

Scattered light means light that scatters outside the intended light path and enters areas that are not to be directly illuminated. It is usually caused by reflections, scattering or unwanted light losses in optical systems and often negatively affects the image quality. These scattered light beams thus (possibly unintentionally) enter the shadow area of the object and illuminate it.

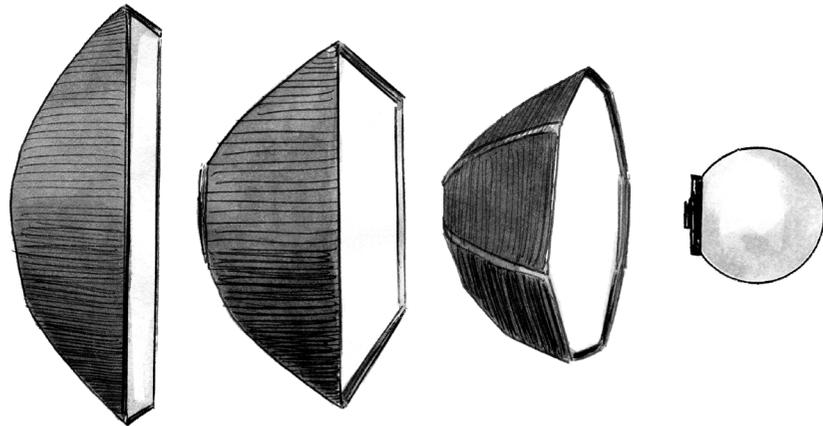
This refers not only to shadows on the background or foreground, but also to the 'body shadow' on the object itself. However, scattered light can also be reflected from walls, ceilings and floors. The distance between these surfaces and the object, as well as their colour (white, grey or black), are also decisive factors.

Also known as scattered light is the light that enters the lens from the outside and does not fall directly on the image sensor or the focused area. You can avoid this by working with a lens hood in the studio.

## 5. Shadow depth and scattered light

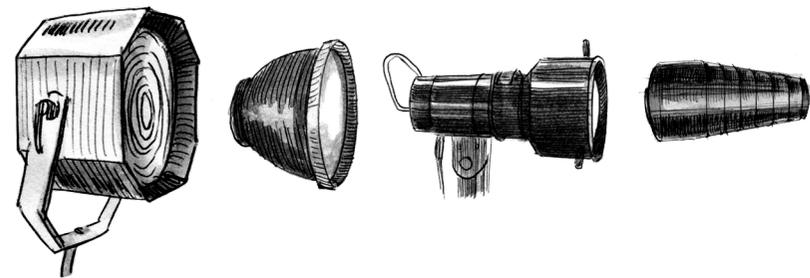
### 5.1. Soft light – wide beam angle – lots of scattered light – shallow shadows

A panel light, e.g. a softbox, produces a lot of scattered light thanks to its diffuser. The further away it is from the object, the more effective the scattered light becomes and the lower the shadow depth.



### 5.2. Hard light – small light source

A hard light source with a small beam angle (e.g. Fresnel spot, projection spot, reflector with honeycomb grid) illuminates only the object or setup. This keeps the shadow depth much darker.

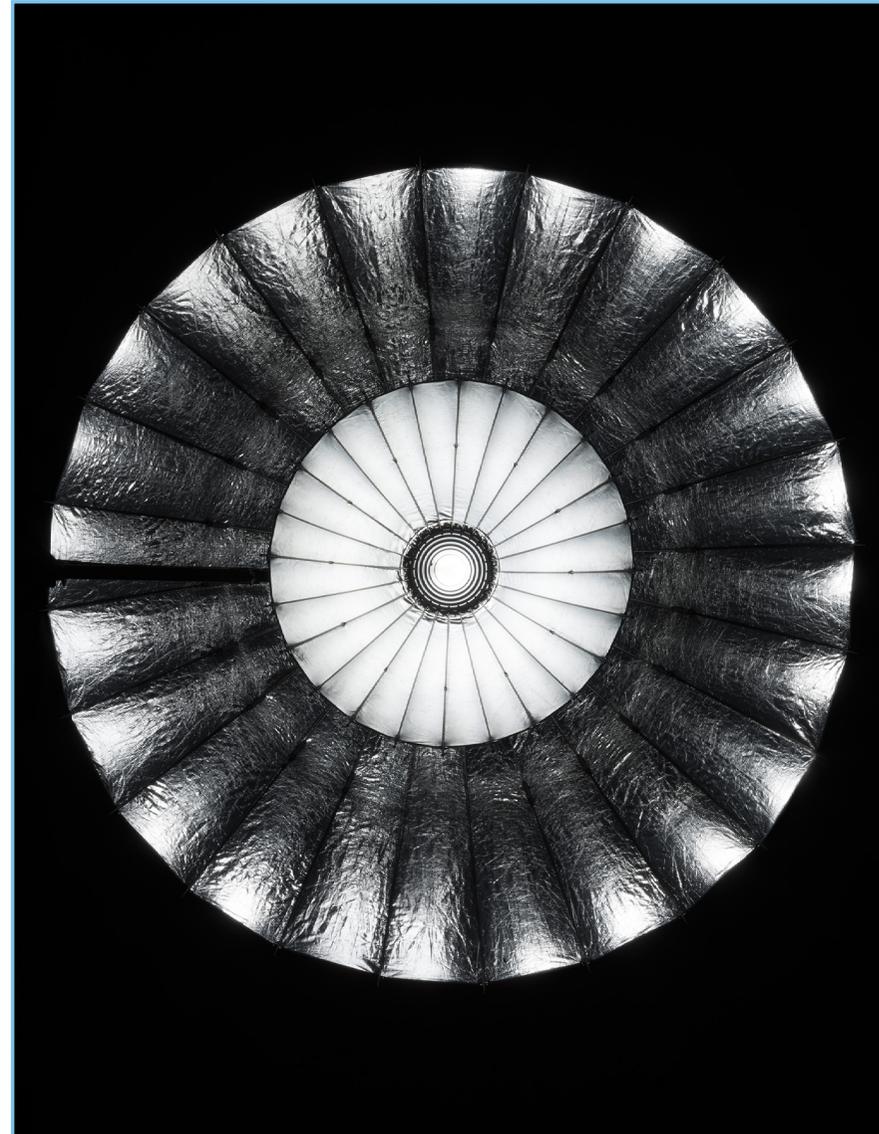


## 6. Highlights/Spots

Highlights/Hotspots are the brightest areas of an image where light is reflected most strongly. These bright spots often occur where light sources hit shiny or reflective surfaces directly, such as metallic objects, shiny skin or water surfaces.

Spots can be large or small, rectangular or round, uniform or centred.

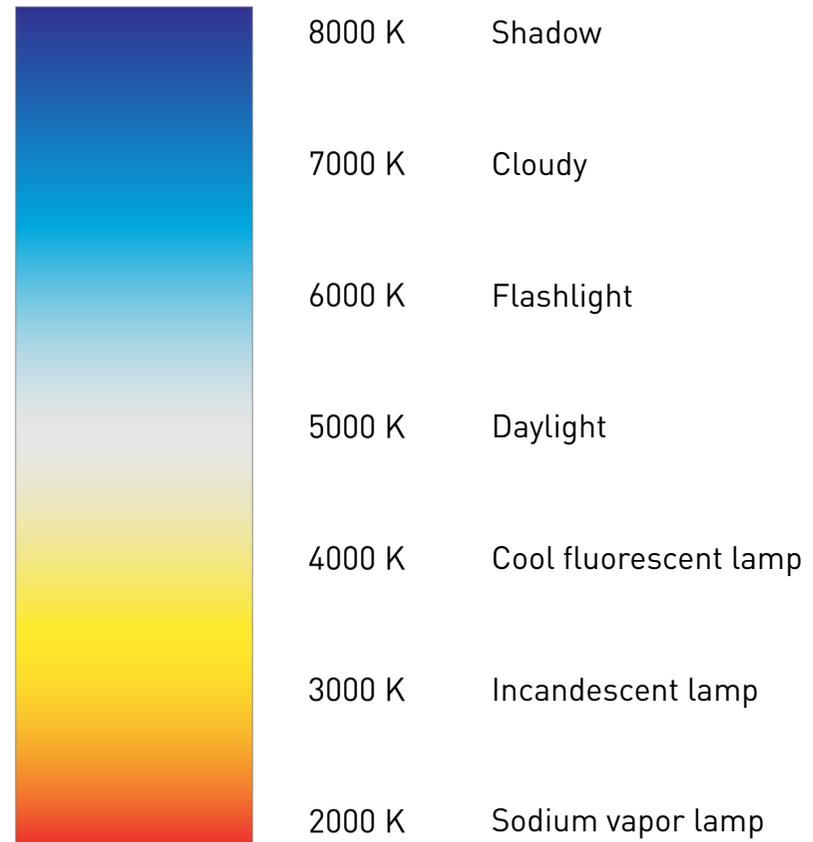
They may have detailed markings or be blown out. You can learn about its shape, size, as well as light and illumination, especially from a softbox diffuser.



## 7. White balance

White balance (WB) is the adaptation of the camera to the colour temperature of the light in order to reproduce the colours in an image as faithfully as possible.

The aim of white balance is to correct the effect of light sources that can cause different colour temperatures and thus different colour casts.



## 8. Colour temperature

The colour temperature describes the spectral composition of the light and thus the colour effect of a light source. It is measured in Kelvin (K).

The colour perception changes depending on the temperature of the light:

**Warm colours:** Low colour temperatures around 2000 – 3000K, such as candlelight or sunrise, produce warm, yellowish tones.

**Neutral colours:** Medium colour temperatures around 5000 – 5500K, such as daylight, appear neutral and balanced.

**Cool colours:** High colour temperatures above 6000K, such as overcast skies or shadows, produce cooler, bluish tones.

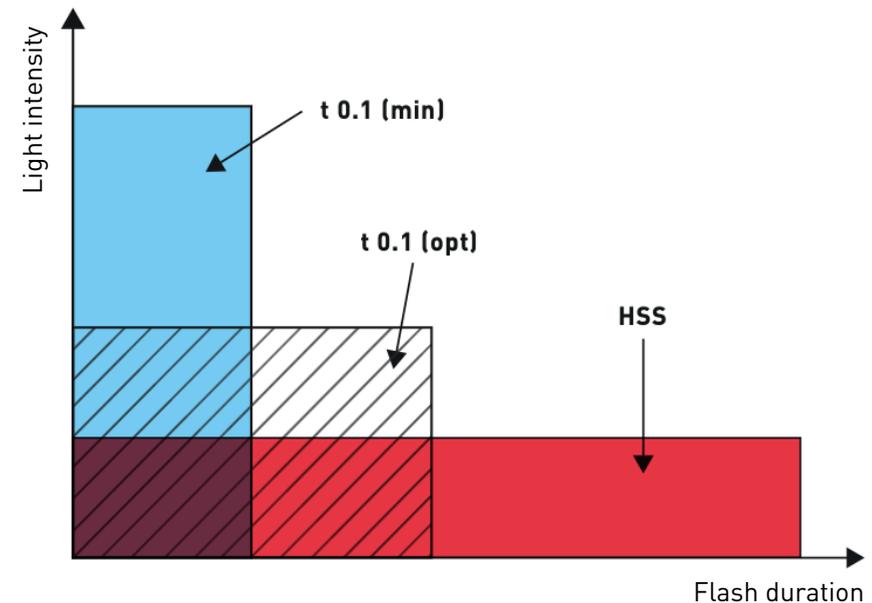
When light comes from different sources, e.g. lamps and available light, different colour temperatures collide.

In photography, the colour temperature is often corrected via the white balance to avoid colour distortions and to adapt the colours to the natural impression.

## 9. Colour consistency

In photography, colour constancy describes the ability to consistently reproduce colours regardless of changes in light intensity, flash setting, or ambient temperature. Colour shifts occur in many flash systems when the flash tube is heated or in fast sequential flashes, which can lead to uneven colour results.

The power variation due to voltage adjustment in the capacitors is another reason for colour shifts. High-end flash systems therefore regulate the light output differently.



## II. Flash photography terms

10. Joules and watt-seconds	31
11. Flash duration	32
12. Flash sync time	33
13. Flash triggering	34
14. Flash scattering/diffusion	36
15. Flash correction	37
16. Direct/Indirect flash	38
17. High Speed Sync (HSS)	39
18. Strobe flash	40
19. Alternate	41
20. Delay	42
21. Sequence	42
22. Interval	42

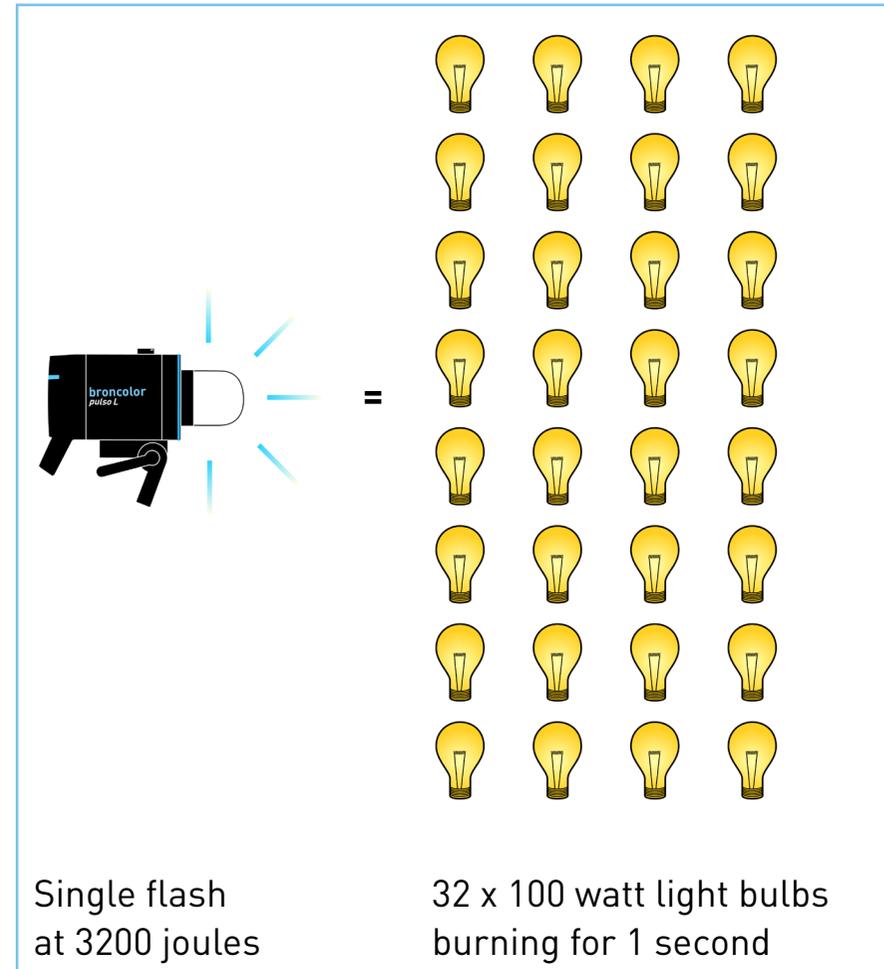
## 10. Joules and watt-seconds

The power of an electronic flash depends on the size of the capacitors used and the level of the charging voltage and is usually measured by the energy stored in the capacitor unit, in watt seconds or 'joules', named after the physicist J. P. Joule.

However, this measurement does not take into account losses in cables and in the flash tube itself. It is therefore quite possible that two devices with the same joule energy may have different light outputs.

### Example

Pulso L (3200 joules)



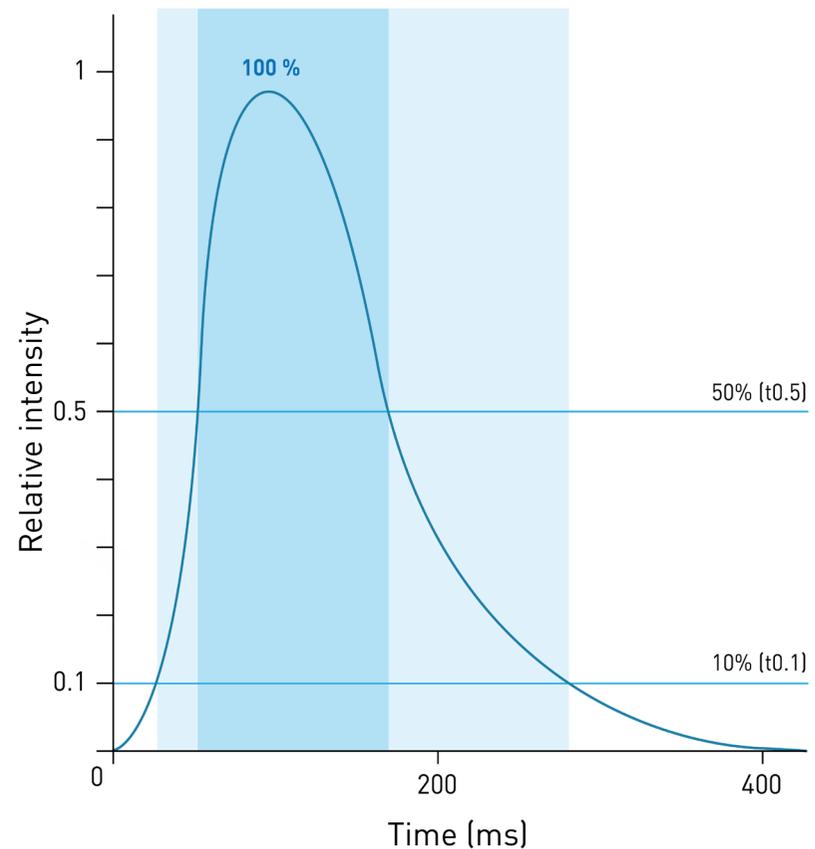
## 11. Flash duration

The duration of a flash discharge refers to the ability of a flash device to capture or 'freeze' a moving object.

With  $t_{0.1}$ , the flash duration is defined as the time during which the intensity exceeds 10% of its maximum value.

In general, the  $t = 0.1$  flash duration is approximately three times as long as the  $t_{0.5}$  (intensity exceeds 50% of the maximum value) value.

$T_{0.1}$  min shortest flash burn time available without colour consistency, depending on power.



## 12. Flash sync time

Flash sync time is the shortest shutter speed at which the entire camera sensor is exposed by the flash.

With shorter shutter speeds, only part of the sensor could be illuminated.

In the near future, the global shutter will render this irrelevant.

### Shutter speed

1/125

1/60

1/30

1/15

1/8

1/4

1/2

1

2

4

8

16

...

## 13. Flash triggering

### **Wired triggering**

**Synchronisation cable:** A cable connects the camera directly to the flash system. When the camera is triggered, a signal is sent via the cable, which fires the flash.

Advantages: Reliable and no interference from radio signals.

Disadvantages: Restriction of freedom of movement due to the cable.

### **Radio remote trigger**

**Radio trigger:** A radio remote control, consisting of a transmitter (on the camera) and a receiver (on the flash unit), triggers the flash wirelessly.

Advantages: Flexibility and greater range (up to 100 metres or more, depending on the model).

Disadvantages: In rare cases, it may be disrupted by other radio signals.

### **Infrared trigger**

The camera sends an infrared signal to the flash or an infrared receiver unit, which fires the flash.

Advantages: Works well on short distances and indoors.

Disadvantages: Line of sight required, sensitive to obstacles.

## 13. Flash triggering

### **Optical triggering**

A built-in or external sensor on the flash unit detects the light from another flash (e.g. the camera's internal flash) and triggers the flash unit.

Advantages: Easy to use and without additional equipment.

Disadvantages: May be accidentally triggered by other light sources.

### **Bluetooth or WLAN (modern systems)**

Some newer cameras and flash units communicate with each other via Bluetooth or Wi-Fi.

Advantages: Flexibility and integration into apps for smartphones or tablets.

Disadvantages: Higher power consumption and potential compatibility issues.

The choice of system depends on the type of photography, the equipment available and individual requirements.

## 14. Flash diffusion

Flash diffusion refers to the distribution of light to make it softer and more even. This can be achieved using diffusers, softboxes or indirect flashes via ceilings or walls.



## 15. Flash correction (especially for speedlights)

With the flash correction, the flash power can be adjusted in fine gradations, especially for speedlights, in order to optimise the exposure.

Positive flash correction increases flash intensity while negative correction decreases it.

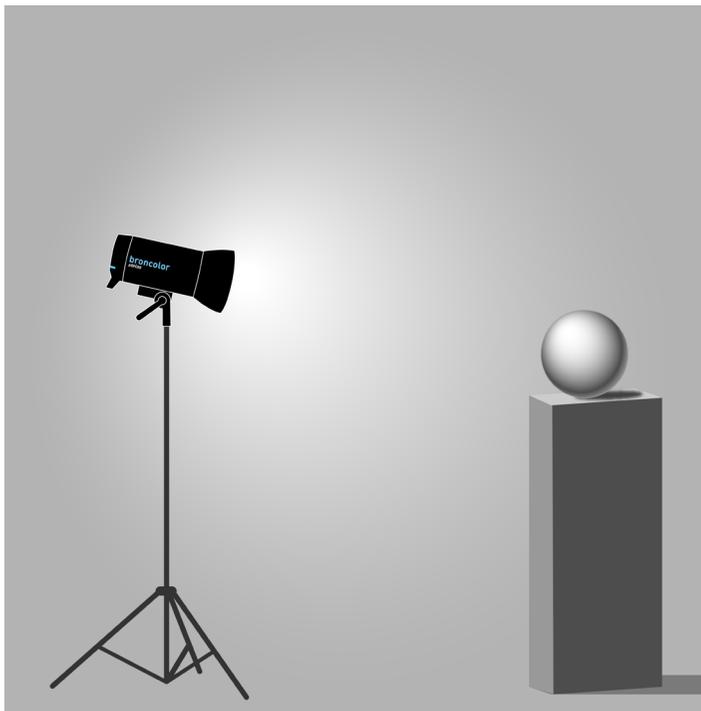
For generators and monolights, the luminaires can each be controlled separately in terms of flash power.



## 16. Direct and indirect flash

### 1.1. Direct flash

The flash illuminates the subject directly, which can result in harsh shadows depending on the light modifiers used.



### 1.2. Indirect flash

The flash is released via reflective surfaces (e.g. walls, ceilings) to scatter the light and make it softer.



## 17. High Speed Sync (HSS)

High Speed Sync is a flash technique that makes it possible to flash even at very short shutter speeds (below the flash sync time).

This is especially useful if you want to use a large aperture in a lot of ambient light.

More information



## 18. Strobe flash

In strobe flash, the flash emits a series of short light pulses within a single exposure.

This creates a multiple exposure effect where the subject is captured at different stages of a movement.



## 19. Alternate

The Alternate Release function enables faster trigger sequences.

This function allows shorter sequences that are four times faster to be achieved at higher energy levels.

It is also possible to reduce the interval between stroboscopic sequences to a minimum of 0.01 seconds.

With 2 flashes, Alternate is also referred to as a 'free mask'.



## 20. Delay

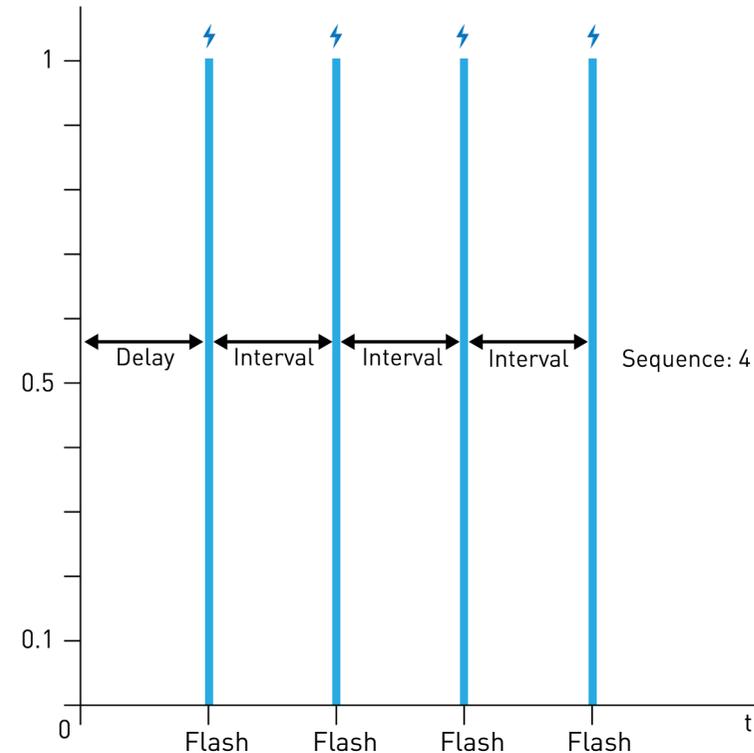
The delay refers to the time between the flash being triggered (e.g. by a radio transmitter) and the visible flash. The maximum value for this delay is 50 seconds.

## 21. Sequence

The Sequence function refers to the triggering of a series of several pre-programmed flashes.

## 22. Interval

The Interval function is used to set the duration between two consecutive flashes in a sequence.



## III. Light

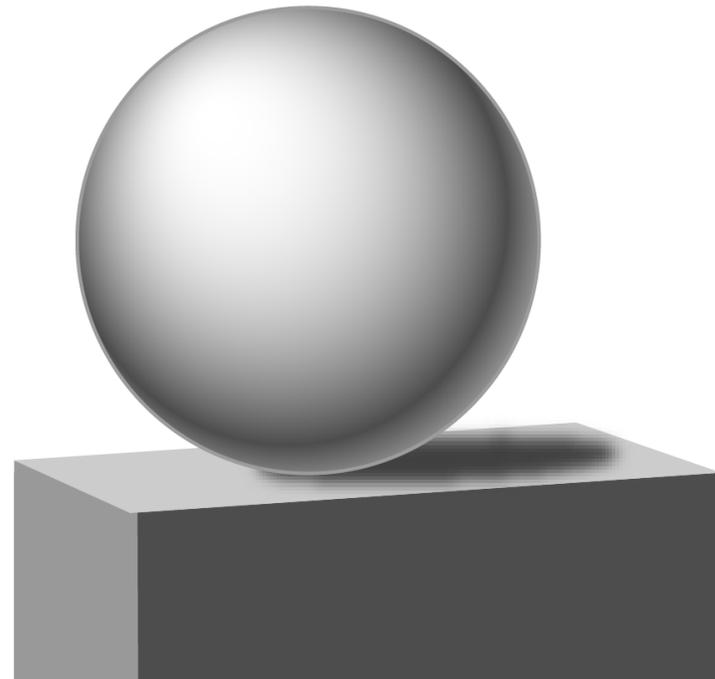
23. Hard light	45
24. Soft light	47
25. Diffuse light	49

### **What are the three basic categories of flash light?**

Considering the hardness (or softness) of the light is certainly the simplest and easiest way to classify it.

However, you can never call a particular light shaper hard or soft (except for a point light source that is always hard).

Depending on the size and distance between the object and the light, the same light shaper can be hard, soft or even diffuse.



## 23. Hard light

A very small light source compared to the object (e.g. point light source) emits 'hard' light. The shadows created are sharply defined, and a wall behind the object shows only two forms of illumination: an illuminated area and an umbra.

The distance between the light source and the object has no influence on the hardness of the light.

The situation is different when the 'hard' light source exceeds a certain minimum size. Illuminating a person with the normal reflector from a distance of about 10 m results in very hard shadows.

However, illuminating a smaller object (e.g. matchbox) with the same reflector from a smaller distance (approx. 10 cm) achieves much softer shadows.

Hard light achieves a great contrast between light and shadow with emphasis on the surface structure of the object.

This technique is well suited for recording textiles and food as well as for simulating sunlight when using studio light.

Ultimately, the hardness of the light has an influence on the colour saturation. Small and hard lights increase the saturation of the image, while soft and especially diffuse lights reduce it.

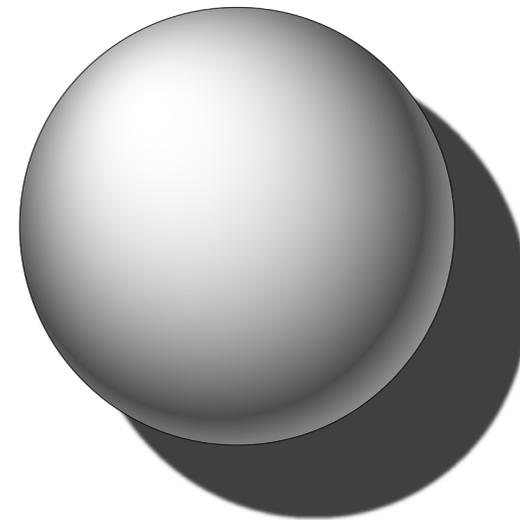
## 23. Hard light

### 23.1. Hard light source

A hard light source is a light source that produces sharp, well-defined shadows. This occurs when the light hits the subject directly and in a concentrated beam and comes from a relatively small or point-like source (standard reflector, reflector with honeycomb grid, spot, etc.), creating only small, point-like highlights.

The further away the light source is, the smaller the highlight becomes and thus the overall light becomes harder but less contrasty due to the resulting scattered light.

The following light modifiers can be used for hard light: All open reflectors, standard/normal reflectors, tubes.



## 24. Soft light

A light source of approximately the same size as the object emits a soft light. A wall behind the object now shows a new shadow zone – between the fully illuminated areas and the core shadow, a gradation from light to dark is created.

This zone is called the penumbra. Therefore, the distance between the light source and the object has an important influence on the size of the penumbra and the softness of the light.

As the distance between the light source and the object increases, the light becomes harder, while it becomes softer as the distance decreases.

Shadows become softer when using a soft light source. The quality of this light is similar to that produced by a window without direct sunlight.

This lighting technique is good for portrait and fashion photography as well as stills.



## 24. Soft light

### 24.1. Soft light source

By soft light sources, we mean surface lights, which produce a lot of scattered light through their diffusers. The illuminated surface is visible as a reflection. It therefore produces a relatively large highlight.

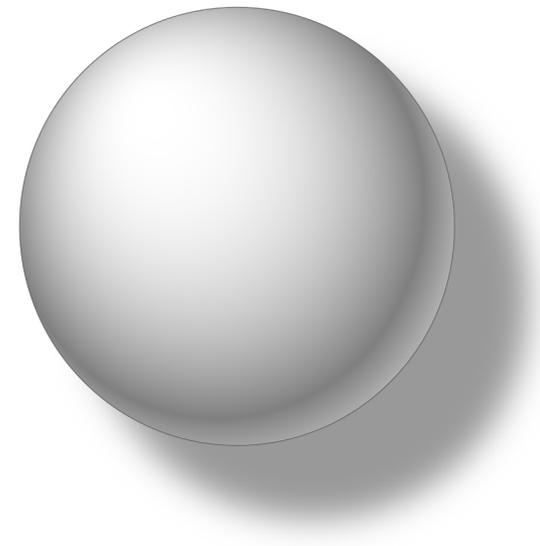
The larger the surface light and/or the closer it is, the larger the highlight becomes. The further away it is from the object, the more effective the scattered light becomes and the lower the shadow depth.

Finally, the colour saturation is somewhere between that of hard light (high) and that of diffuse light (low).

Since our light source is soft, it has a certain size (it is no longer a point) and the distance to it becomes very important:

The following light modifiers can be used for soft light:

softboxes or octaboxes of any size (choose the dimensions and position carefully!) Acrylic and beauty lights, para reflectors, shades.



## 25. Diffused light

A very large light source produces diffuse light. If it is large enough, the hardness or softness of the light is more or less independent of the distance from the object to the light source.

A wall behind the object is illuminated to a certain extent across its entire surface. The umbra disappears completely or is replaced by a well-graded penumbra.

The shadows and surface structure of the object and background tend to disappear when using a diffuse light source.

The surface structure of the object is smoothed out. This type of light is particularly suitable for

concealing wrinkles in beauty photography. In nature, this perfectly diffuse light occurs when the sky is completely overcast.

This technique is suitable for beauty, portrait and automotive photography, as well as for fill light in combination with a hard or soft main light.

The light no longer indicates direction, and the only contrast that remains in the photo is the contrast of the object itself.

The structure of the surface of the object is as flat as possible, almost invisible and the colour saturation is greatly reduced.

## 25. Diffused light

### 25.1. Diffused light sources

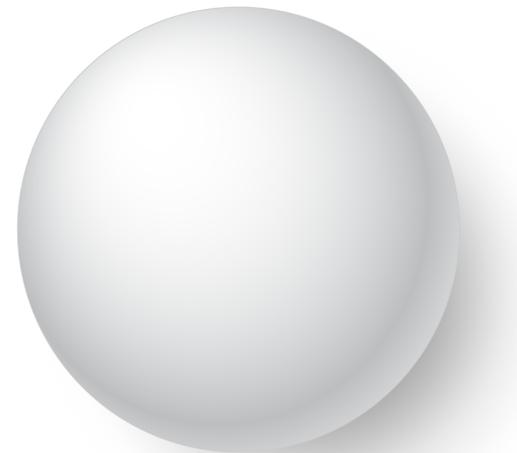
Diffused light sources are known to be very large area lights. The light surface is therefore visible as a large reflection. This creates a very large highlight. The larger the area light and/or the closer it is, the larger the reflection will be.

The following light modifiers can be used for diffuse light:

Large softboxes and octaboxes at a short distance for smaller objects.

Indirect light reflected from several bright walls, (these walls must be colour-neutral to avoid colour shift).

Light tents wrapped around the object.



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