

Buyer's Guide for Operation Theatre Lights

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Major Choice: Halogen? Xenon? LED?

When you, the hospital owners or the surgeons are looking for Operation Theatre light, the first obvious question to your mind is whether to buy a Halogen or Xenon or LED lights. LED lights offer the following advantages over Halogen and Xenon lights:

Whiteness of the light

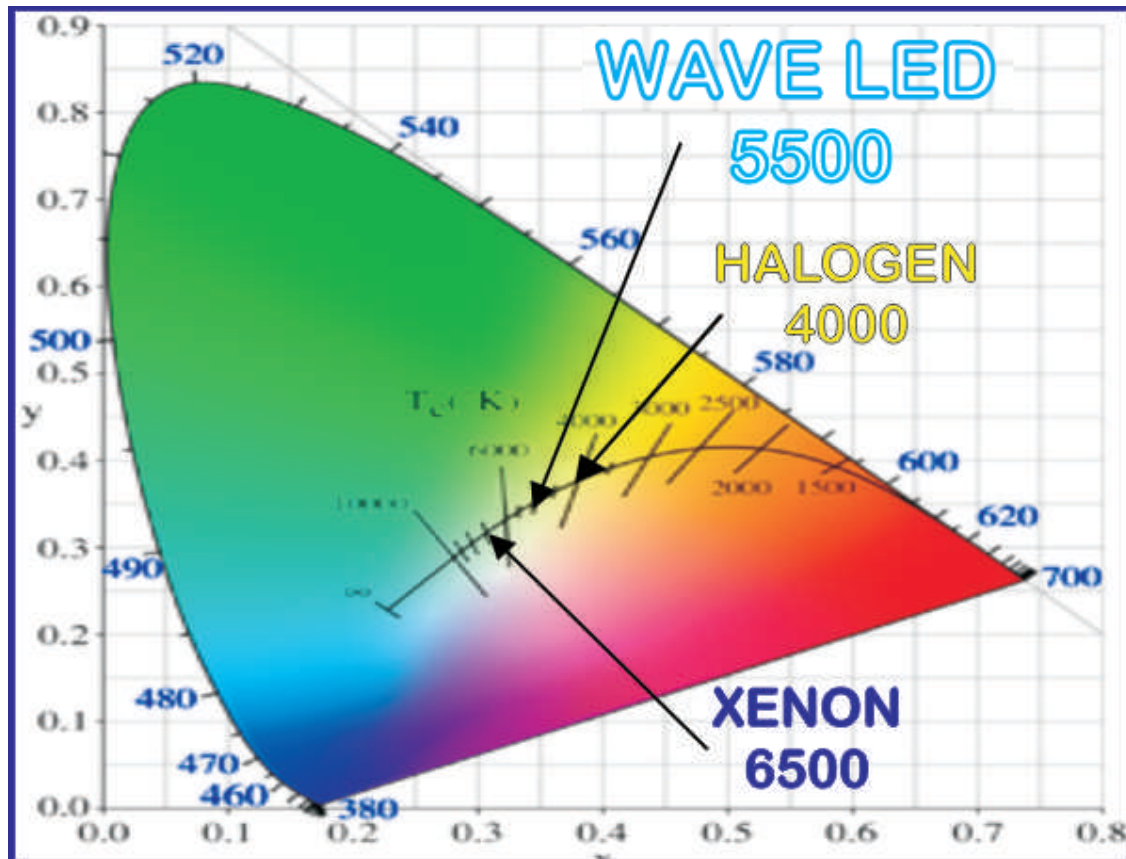


Figure 1: Colour temperature of various light sources.

While Halogen light is slightly yellow light, Xenon light is slightly blue light.

Life of light

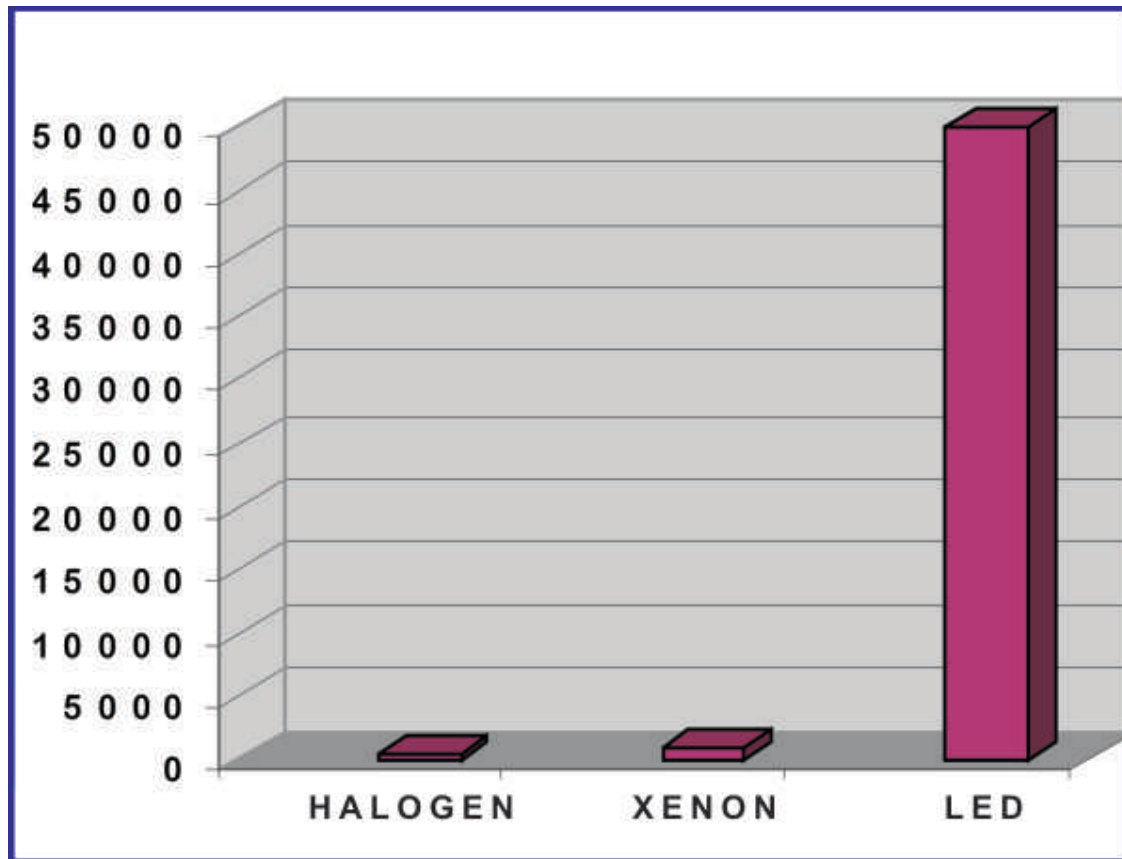


Figure 2:Life expectancy of various lights.

LED lights have typical life of 50,000 hours while halogen (500 hours) and xenon (1000 hours) have much lower life.

Also, it is important to note that LED lights technology has advanced recently and has overcome its earlier limitations. Specifically, the following advancements are particularly important:

1. **Colour stabilisation:** LED lights of a few years ago did not have stabilised colour. So, it was possible that two LED lights from same manufacturer varied the colour slightly. With recent developments, the LED lights have colour stabilisation that works with accuracy of $\pm 2\%$ over many years.
2. **Higher luminance per wattage:** The efficiency of LED lights is anyway better than halogen and xenon lights. The good news is that the efficiency continues to improve. The side effect of this development is that the heat generated by LED lights is getting lower and lower.

So, the obvious choice for you will be LED lights.

Medical grade LED lights

Now that you have decided to go for LED lights instead of halogen and xenon, the next consideration should be look for the right LED lights. By “right” LED lights, we mean medical grade LED lights. So, just what are medical grade LED lights? I am glad you asked. Here are five important characteristics of medical grade LED lights:

Colour temperature

Technically speaking, it is temperature at which a black body would emit radiation of the same colour as a given object. Colour temperature is conventionally expressed in Kelvins, using the symbol K. As seen in the Figure 1, the colour temperature of around 5500 K is closer to the noon Sunlight. This is the whitest colour, which helps us to identify the true colours of the objects under this light.

It is recommended that LED lights selected have the colour temperature of around 5500 K. Medical grade LED lights will have this colour temperature.

Colour Rendering Index

Colour rendering index is a quantitative measure of the ability of a light source to reveal the colours of various objects faithfully in comparison with an ideal or natural light source.

The requirement of a good light (from the correct perceived colour point of view) are:

1. displays a vast variety of colours
2. makes it easy to distinguish slight shades of colour, and
3. the colours of the objects look natural

Colour rendering index is designed to measure the ability of the light source to achieve the above objectives. It is a quantitative measure whose maximum value can be 100, which the most ideal light.

It is important to note that a light having all the colours (rainbow colours) in equal proportion will have high colour rendering index.

Medical grade LED lights have colour rendering index more than 90.

Stable colour temperature across intensities and over long life

While colour temperature is important, it is also important to maintain the stable colour temperature across intensities. Medical grade LED lights will maintain the same colour temperature even at lower intensities such as 2% or 5%. The colour temperature is also maintained by them even after many years of usage.

Truncated light (absence of Ultraviolet and Infrared lights)

The visible light ranges from R (red) to V (violet) in VIBGYOR. Any light below the visible range is called as Infrared and any light above the range is called ultraviolet light. It is well known that the invisible lights are harmful to the human body (particularly skin and hair). While it may acceptable for a patient to be exposed to such a light once, repeated exposure to the surgeon and the staff is not advisable. So, the surgeons should look for LED lights that have nil invisible lights. Medical grade LED lights ensure that this requirement is also met.

Operational considerations for light

Shadow-less light

The fundamental property of light is to travel in straight line and thus cause shadows. While it is not possible to change property of light, it is possible to arrange light in such a way that shadow is minimised. So, please understand that shadow-less is just a marketing word and the actual meaning is less-shadow.

Compare shadow of a cricket player in a day match to the shadow in a night match. In the first case, the shadow is thicker while in the second case there are multiple weak shadows. This happens because in the second case, there are multiple light sources. The same principle is used in Operation Theatre lights.

Different manufacturers achieve shadow-less performance differently. Therefore, it is recommended that you check the shadow-less performance by obstructing the light with your head or hand closer to the light.

Focus of light

When the light is fully focused, the radius of the light should be at least 15 cm. This is the minimum amount of area that needs light during surgery. When the light is gradually defocused, it should increase its radius gradually while maintaining the circular shape and uniformity of light intensity up to 30 cm in radius. Beyond this radius, it does not matter if it maintains the circular shape or uniformity of light intensity anyway because the resultant intensity (because of spreading the light) would be lower than practically required for surgery.

Typically, the distance between the light and the surgery area is 100 cm. However, the focus of the light should be achievable at distance of at least 70 cm and up to 120 cm because it is not possible, in many cases, to maintain the exact distance of 100 cm, for reasons like Height of surgeon, height of OT table, position of patient and operative area, room dimensions, etc...

Intensity of light

Generally, it is accepted that intensity of around 1,00,000 lux is sufficient for most applications. It should be possible to vary intensity in granular steps (e.g. 1% per step) so that you can set the intensity at the desired level. Some applications like laparoscopic surgery need light at around 5,000 lux. So, it should be possible to set low percentage of intensity.

Lux meter can be used by you to check if the light is giving the promised intensity.

Heat generation

The LED lights do not elevate the operating area temperature as much as halogen and xenon. Look for LED lights that limit the heat generation to elevation of up to 2 degrees.

Movement of the arm

Smoothness of the movement

When the surgeon is moving the OT light to illuminate the surgery area, his/her focus is on the surgery area. The movement should be so smooth that without looking at the dome, he/she is able to adjust the light in a smooth and easy manner. Also, once the surgeon releases the dome, it should remain stable at exactly the same position that was released.

360 degree motions

The motions of the light dome should be 360 degrees without any stopper. This ensures the movement is without any restrictions and with achieved in less time.

Schematic diagram of the typical Operation Theatre Light - Position, Movement and Space

Other considerations

Suitability for laminar flow system

The OT light dome should not obstruct the laminar air flow. So, the domes should be aerodynamic and in petal shape.

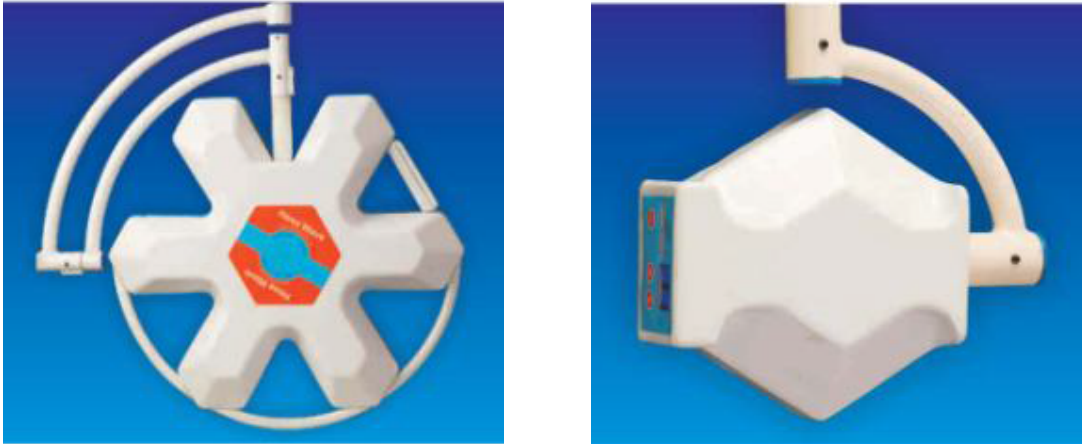


Figure 3: Aerodynamic and petal shape of OT light dome

Selecting the right configuration

Number of domes

Different applications need different number of domes. Typically, surgeries done at multiple sites would need more number of domes. The most commonly followed convention is as follows:

One dome is sufficient for even major OTs, provided there is just one operative surgeon and one operative site.

Two domes are recommended where two operative surgeons are involved or where two operating sites are being operated

Three domes are recommended where two or more operative surgeons are involved or where more than two operating sites are being operated

Light Intensity

Different manufacturers and within a manufacturer, different models have different peak intensity.

The required intensity is dependent upon the depth of the operative area from the surface, for example skin or hair surgeries would not need more than 50,000 Lux, while gynec surgeries may require 80,000 Lux or more. Same way if your operative area is bigger in size, you may prefer higher intensities so that even slight defocused light would give you wider area with little reduced light.

Ceiling or mobile

If surgeon's operative room is fixed, Ceiling light is most ideal. As it gives the flexibility of movement without any disturbances like mobile light which comes in way while moving within OT.

The advantage of Mobile or Portable light is its own movement, which allows it to be moved from one room to other room, or some times temporary converting a single surgeons OT to two surgeons OT.

Additional Facilities

Wireless remote control for sterility issue

Camera at the center of the dome to view, telecast, record, ... in side the OT or nearby vicinity, say for other surgeon or support staff within OT, patients relative outside OT, conducting workshop and sharing OT procedure with participants or students in next room, etc...

Parting Remarks

You would have understood that our OT lights i.e. Wave Visions' HexaWave LED OT lights meet all the above considerations.