SLIDE CHANGE

Types Of Surgical Lights

Surgical lights provide the surgical team with bright, consistent lighting focused on the operation table during surgery. Surgical lights can be categorized based on the light type as either incandescent (conventional), LED lights and Halogen lights. There are many different types of lighting technologies to choose from. Knowing the difference between incandescent and LED and the difference between halogen and LED can help you make an educated decision on what's best for your application and budget.

SLIDE CHANGE

INCANDESCENT

This well-known lighting type is the most dated and least efficient. Much like in a space heater, an electric current passes through thin filament wire, which heats the filament until it glows. Heat radiates outward from the space heater as it does in an incandescent bulb, and only a small portion of the energy created is converted into usable light; the considerable amount of heat burns the bulb's tungsten filament until it breaks.

SLIDE CHANGE

SOME POINTS OF INCANDESCENT BULBS

- Incandescent bulbs use—at most—10 percent of the energy they consume to make visible light; the other 90 percent is wasted heat.
- They produce a considerable amount of infrared (IR) and ultraviolet (UV) radiation that can be damaging to fabrics and artwork over time.
- They're designed to last around 1,200 hours.
- Incandescent bulbs have a fragile glass envelope and brittle filament wire.
- These bulbs are relatively cheap but consume so much energy that standard 40- and 60-watt options are no longer available for purchase in the U.S.
- They create a warm yellow light.

SLIDE CHANGE

Halogen:

Halogen bulbs are similar to incandescent bulbs but with a couple minor differences. They contain a tungsten filament, but unlike in incandescent bulbs, a small amount of halogen gas mixes with tungsten vapor and deposits it back onto the filament instead of on the inside of the bulb envelope. This process extends the bulb's lifespan and allows it to work at a much higher temperature than incandescent bulbs, which increases light output. A quartz envelope is used instead of glass because of its ability to handle higher temperatures.

SLIDE CHANGE

FEATURES

- Halogen bulbs come in many shapes but are commonly used as PAR, BR, AR, and MR spotlight or flood light bulbs.
- They produce a considerable amount of infrared (IR) and ultraviolet (UV) radiation that can be damaging to fabrics and artwork.
- These bulbs require an extremely hot running temperature to produce light and can cause burns if touched; the high temperature also prevents these bulbs from functioning as well in cold environments.
- Halogen bulbs are extremely sensitive to skin oils, which can cause them to malfunction or burst.
- They last approximately 3,600 hours—three times longer than incandescent bulbs—but are not as efficient as compact fluorescent lamps (CFL) or LED bulbs.
- Halogen bulbs have a fragile quartz envelope and brittle filament wire.
- Because they operate at higher temperatures, halogen bulbs have higher color temperatures and produce brighter light than incandescent bulbs.

SLIDE CHANGE

LED

- Light-emitting diode (LED) lights have been a revolutionary improvement in the field of surgical lighting, virtually eliminating the problem of infrared radiation caused by excessive heat. LEDs produce the longest-lasting, most energy-efficient lighting available today. A semiconductor rich in electrons and a semiconductor rich in holes are used to create an LED. Passing a current through the junction of these two materials combines the electrons with the holes and produces photons, which is the light that you see. LEDs have endless application possibilities, such as under-cabinet, landscape, vehicle, home, industrial, and commercial lighting.

SLIDE CHANGE

FEATURES

- LEDs run much cooler than incandescent and halogen bulbs, which greatly increases their longevity and enables them to function in cold temperatures.
- Unless an LED is specifically infrared (IR) or ultraviolet (UV), it produces little to no IR or UV radiation, which can be damaging to fabrics and artwork.
- They can last up to 50,000 hours—42 times longer than incandescent bulbs and 13 times longer than halogen bulbs.
- Power consumption is the lowest compared to all other lighting technologies—80 percent less than incandescent bulbs and 75 percent less than halogen bulbs.
- The shatterproof bulbs are shock resistant and have no brittle filaments.
- LEDs require higher initial investment but produce greater energy returns over time.
- LEDs contain no mercury, harmful gasses, or toxins.
- They are available in many different whites and colors.
- Because of their low power consumption, LEDs are great alternative lighting solutions for solar-powered systems.

SLIDE CHANGE

LEDs are the current state-of-the-art light source for surgical lights. LED lights relies on a semiconductor technology and have many advantages over incandescent bulbs.

Benefits of LED Surgical Lights

- Brighter white colors
- More accurate colors
- Significantly more energy efficient
- Last much longer (20x-30x longer)
- Emit virtually no heat

SLIDE CHANGE

LIGHTING METHODS COMMON TO OPERATING ROOM

Quality lighting is critical for every operating room, and the method of light varies depending on staff needs. Three of the most prevalent methods are:

1. Overhead/operating lights
2. Headlamps/illuminated loupes
3. In-cavity lighting

I will define each and analyze its advantages or disadvantages.

SLIDE CHANGE

Overhead/operating lights

Overhead lights are usually either LED or incandescent. The lighting fixture can be mounted on a ceiling or wall and have handles that allow the surgeon to adjust the lighting as they see fit. It is also adjustable to help prevent glare. One challenge with overhead lighting is the possibility of not *precisely* illuminating the operating room.

These types of light allow for something called the “brute force approach,” which floods the operative site with large amounts of light. It can create a diffused light pattern with strategic lenses.

If you are considering new OR lights, you need to assess factors such as shadow reduction and heat generation.

SLIDE CHANGE

Headlamps / illuminated loupes

Headlamps can offer brightness, dependability and comfort for surgeons. The lights are wearable and allow light to follow the attention of the surgeon. Headlamps help create mobility for the surgeon and shadow - free illumination.

They can be battery-powered or connected to a standalone light source with a fiber optic cable. They offer brilliant clarity and ease-of-use.

Surgical loupes are small magnifying devices that are typically attached to the lenses or frames of glasses. Often these surgical loupes feature a small lamp attached to the center of the frame to illuminate the operative site. Illuminated surgical loupes are critical in some cases because they enhance and magnify an area during surgeries requiring a high level of dexterity when working with small structures.

When surgeons use magnifying loupes under intensive surgical shadowless lamps for a better view of the surgical field, the total luminance is about 200 times brighter than that of typical office lighting.

SLIDE CHANGE

In-cavity lighting

In-cavity lighting allows for lighting *deep* inside surgical cavities. If current overhead and headlamp lighting are not adequate, in-cavity lighting is a viable option.

With this type of light, the light source is typically outside of the sterile field, meaning it can be a fixed light on its own or connected to a surgical retractor or instrument.

In-cavity lighting can be customized to specific needs and levels of illumination within a surgical corridor.

Because it is typically located outside of the sterile field, in-cavity light supports a nuanced approach:

If surgery is taking place within a deep, minimally invasive corridor, **in-cavity lighting can be used with fiber optics** to eliminate factors such as added heat.

SLIDE CHANGE

TERMINOLOGIES

Lux

Unit for the amount of visible light measured by a luxmeter at a certain point.

Central illuminance (Ec)

Illuminance (measured in lux) at 1m distance from the light emitting surface in the light field centre.

Light field centre

Point in the light field (lighted area) where illuminance reaches maximum lux intensity. It is the reference point for most measurements.

Depth of illumination

The distance between the points of 20% illumination intensity above and below the center point. From the point of maximum illumination, which is the center of the light field 1 meter from the light-emitting surface, the photometer is moved toward the light until the light intensity measured falls to 20% of the maximum value. The distance between the center and this point is defined as L1. The similarly measured distance in the direction away from the light is L2. The depth of illumination without needing to refocus is the sum of the two distances L1 and L2. In the second edition of the IEC standard, published in 2009, the threshold value was revised from 20% to 60%.[1]

Shadow dilution

The light's ability to minimize the effect of obstructions.

Light field diameter (D10)

Diameter of light field around the light field centre, ending where the illuminance reaches 10% of Ec. The value reported is the average of four different cross sections through the light field centre.

D50

Diameter of light field around the light field centre, ending where the illuminance reaches 50% of Ec. The value reported is the average of four different cross sections through the light field centre

SLIDE CHANGE

Surgical Light Field Diameter: Surgical lighting should have the ability to adjust to a wide range of light fields. A light field diameter of D10 is the diameter of light field around the light center, where the illumination is 10 percent Ec. A light diameter of D50 should not exceed 50% of a D10 diameter. The illustration below represents this functionality. The smaller arrow is D50 while the larger arrow is D10. This simply means that 50 percent of the entire pie of light intensity should fall within 50 % of its total diameter.

SLIDE CHANGE

Norms for surgical light[edit]

Some of the standards for surgical lightheads are the following:

- **Homogenous light**: The light should offer good illumination on a flat, narrow or deep surface in a cavity, despite obstacles such as surgeons' heads or hands.
- **Lux**: The central illuminance should be between 160,000 and 40,000 lux.
- **Light field diameter**: The D50 diameter should be at least 50% of D10.
- **Colour rendition**: For the purpose of distinguishing true tissue colour in a cavity, the colour rendering index (Ra) should be between 85 and 100.
- **Backup possibility**: In case of interruption of the power supply, the light should be restored within 5 seconds with at least 50% of the previous lux intensity, but not less than 40,000 lux. Within 40 seconds the light should be completely restored to the original brightness.
- **Announcement**: The IEC document also mentions what needs to be notified to the user. For example, the voltage and power

consumption should be marked on or near the lampholder as well as on the lighthead. In the instructions for use the following should be announced.

- Cleaning and decontamination of the surgical light
- Safety aspects of the optical filter (purpose and warning to prevent removal)
- Central illuminance
- Light field diameter
- Depth of illumination
- Shadow dilution
- Correlated colour temperature[1] and colour rendering index
- Total irradiance
- Cleaning and disinfecting
- Handling of the lighthead in case of failure
- How the user should respect the national rules for hygiene and disinfecting

Thank you I hope I was clear about my points in presentation.Now I would handover to Akshat for further presentation.