

Maintaining a surgical lamp

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 - electrical safety



13.6.3 Maintaining a surgical lamp

Unit B 13.6 Maintaining theatre and surgery equipment

Module 279 18 B Medical Instrumentation I

Surgical lamp: Lighting function

Operating rooms can have several lighting sources.

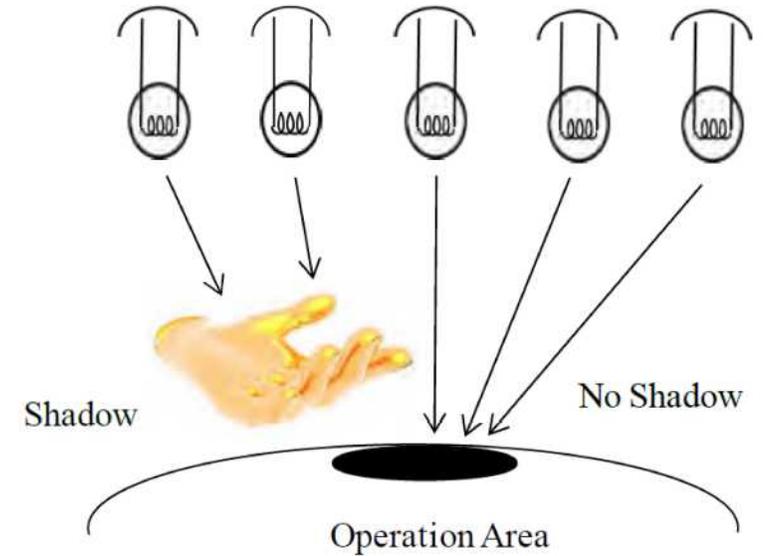
- **General room lighting** in the ceiling. Used during the set up of the rooms, cleaning and as lighting for the staff who are not working in the sterile field.
- The **overhead operating room lights**. These can be large reflectors with one or more bulbs in them, mounted on a **counter-balanced arm** that can be positioned over the site of the operation. These units have a **sterile positioning handle** that is often adjusted over the period of the operation.
- Sometimes: a **mobile operating room light**. These are large reflector lights that roll from room to room. They simply plug in to a 220 volt outlet and are positioned as needed by the surgeons.
- Sometimes: a **personal head light** that a surgeon wears. This is a lens that focuses light transmitted to it by a fiber optic cable from a remote light source. This light source may have a multitude of bulbs in it that can be switched into use via a knob on the top of the unit.



Surgical lamp: Use

Positioning adjustment; sterile operation

For overhead lights, the distance from the lower edge of the light to the operating table should be approximately one meter. Initial positioning is accomplished by using the rail on the lamp housing to move it into place. The surgeon can adjust the light using the centre hand grip, which is provided with a replaceable, sterilized sleeve.



shadow less

true white light providing true color

intensity adjustment

impacting air flow (ventilation system)

Surgical lamp: Scientific principles

Illumination level is measured in foot-candles or lux (1 foot-candle equals 10.764 lux).

- At **1 or 2 foot-candles**, a room is considered darkened, but large objects can be seen.
- **20 to 200 foot-candles** are required for reading and other common visual activities.
- The Illuminating Engineering Society of North America (IESNA) recommends a minimum illumination level of **2,500 foot-candles** at the surgical site when the light is positioned one meter above the site.
- Some surgeons prefer **3,500 foot-candles** or more for certain procedures.

Surgical lamp: Scientific principles

Colour quality is a measure of the spectral content of the light, expressed by **colour temperature** in **kelvin (K)**

- The noon sun yields a colour temperature of 5,000 to 6,000 K
- low colour temperatures cause objects to take on a reddish tint, and high colour temperatures cause a bluish tint.
- Under most common lighting conditions, exact colour temperature control is not crucial because of the adaptability of human visual perception; however, because lights in the OR are often illuminating dark red tissues, they must deliver **visible red light** to accentuate contrast and tissue differentiation.
- A colour temperature of 4,000 K will provide adequate brightness and allow the surgeon to distinguish true tissue colours with minimal eyestrain. While IESNA states that an acceptable range for surgical lights is in the 3,500 to 6,700 K range, most surgical lights operate in the **4,000 to 4,500 K** range.
- Distracting differences in appearance can occur if adjacent objects are illuminated by light sources with significantly different color temperatures.

Surgical lamp: Components

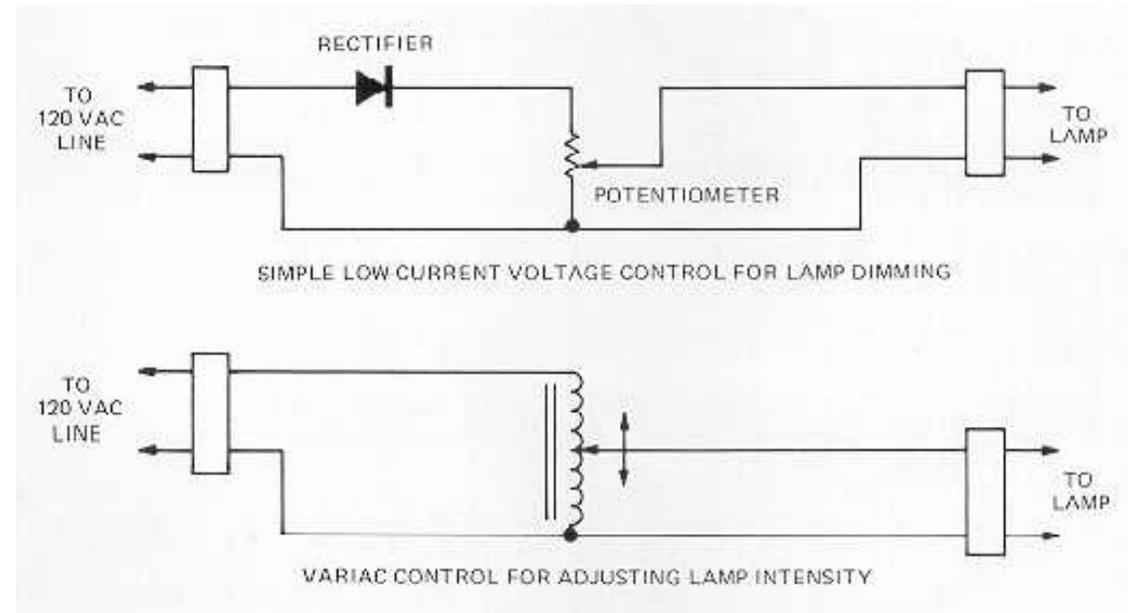
- Infra Red filter: minimize heat
- Reflector: maximize light
- Lamp head: construction
- Counter balanced arm: positioning
- Lamp Rail: positioning
- Control box: control
- Centre hand grip: positioning
- Adjustable sterile handle: positioning
- Lamps lighting



Surgical lamp: Construction

Most operating lamps work directly from the outlet power through a switch.

Some lights have dimming circuits. Older dimmers often work with a rectifier or a variable transformer (variac) gradually varying the voltage applied to the lamp and therefore the intensity of the light delivered.



The overhead operating lights have **control boxes** on the wall where the **intensity** control is located along with the **on/off** controls.

This control box usually contains an SCR (silicon controlled rectifier) control board, or transformer that powers the lights at some voltage under 115 volts.



Surgical lamp: Construction

Some operating room lights use fluorescent bulbs (low-pressure mercury-vapor gas-discharge lamp that uses fluorescence to produce visible light).

Fluorescent bulbs generally operate through a transformer and use a **starting circuit**. In some cases, the bulb is heated before the starter is engaged. The heat causes both a change in the internal tube pressure and an increased electronic flow between the electrodes. A **high voltage (25,000 V) spike** from the starter establishes an arc in the atmosphere between the electrodes. After the initial spike, the bulb will operate at a low current and temperature.

The operation light must be connected to an emergency power system ...



Surgical lamp: Common Problems

Basically there are very few problems when it comes to the surgical lamp and most are user oriented.

In rare cases, patients are reportedly **burned** by multiple lights, e.g. in case heat protection filters are removed.

Special precautions while working with medical lights:

- High intensity lights can cause **blindness** if you look directly into the light.
- Therefore, the light should not be used if the **cover glass or filter system** is damaged
- Your eyes should be **more than 60 cm away** from the lights



There is no calibration needed for operating room lights.
If the light turns on, can change intensity (if so equipped) and stays in place after adjustment, it is ready to use.

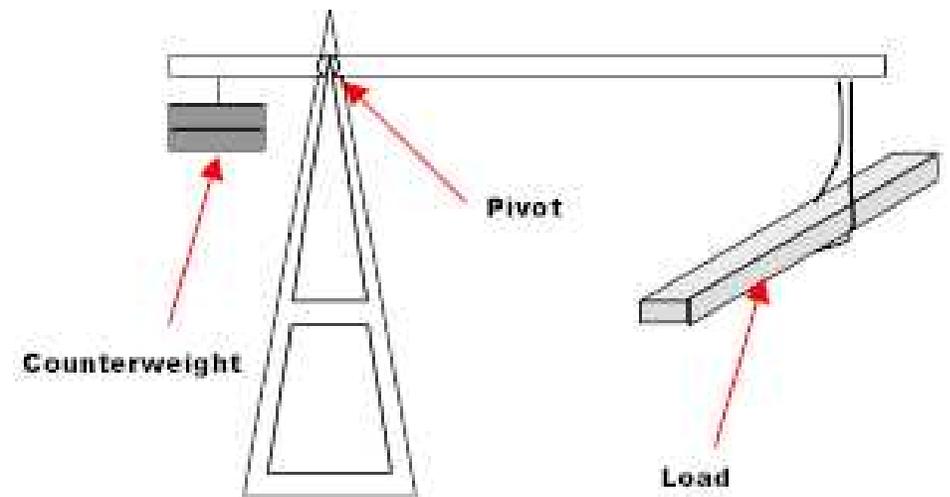
Surgical lamp: Trouble shooting

Many of the surgical lamp problems associated are **mechanical**: they do not stay in the position selected and the **counter weights** have to be adjusted.

A secondary problem is that one or more of the lights will burn out giving **dark spots** in the surgical field.

Preventive Maintenance:

- cleaning
- lubricating
- visual inspection for damage or abnormalities



Surgical lamp: Trouble shooting

Conventionally, surgical lamps can be **xenon, quartz-halogen, mercury-vapor** or **metal halide**. These bulb types are not interchangeable because of the voltage supplying the bulb, the connector for the bulb and the heat generated by the bulb. The bulbs have a life expectancy of about **250 hours** and need to be monitored for replacement.

When replacing bulbs care must be taken to avoid **touching** the reflector part of the bulb as that can affect the brightness at the surgical site. Also, avoid touching the bulb itself. Your fingerprints can cause excessive heating of the glass, dramatically shortening the life of the bulb. If the glass of the bulb has been touched, clean the fingerprints off with alcohol.

It can be very difficult to find and/or import replacement light bulbs. While it may be possible to wire a replacement socket for a more readily available bulb, the engineer must be sure to consider size, voltage, temperature and materials. It maybe more prudent to start with a readily available bulb and socket and design a completely new fixture.

Although more expensive than conventional surgical lights, LED lights have several practical advantages. They generate less heat and have much longer life cycles than traditional lights.

LED surgical lights now represent **the majority of new installations**.

Surgical lamp: Safety considerations

The highest intensity lights can cause **blindness** if you look directly into the light. The light should not be used if the cover glass or filter system is damaged or destroyed.

In placing the light to begin work, your eyes should be more than sixty centimeters away from the source.

Make sure that the cable carrying the main supply is well insulated and of good quality to prevent electrocution, thereby applying safety.

Make sure that the wheels of a mobile lamp are always in good condition for stable standing. Because if the wheels are not in good condition the equipment can fall causing instant injuries.

END

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