

স্বাগতম



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Electro-Medical Department

Code : 86

TESTING AND MAINTENANCE BIOMEDICAL EQUIPMENT

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What Is Installation

Installation is the process of putting something in a position so it can work properly.

What is Calibration

Instrument calibration is one of the primary processes used to maintain instrument accuracy. Calibration is the process of configuring an instrument to provide a result for a sample within an acceptable range. Eliminating or minimizing factors that cause inaccurate measurements is a fundamental aspect of instrumentation design.

Maintenance

The Oxford English Dictionary defines maintenance as: The action or process of preserving (an object, activity etc.).

Unfortunately, to many in industry, maintenance has become synonymous with "fixing things" when they break rather than preserving them in a functional state.

Routine maintenance

Routine maintenance focuses more on general inspection and cleaning. Preventive maintenance targets specific areas or components, such as belts and bearings..

Preventive maintenance

Preventive maintenance is more skill-intensive and time-consuming, involving more detailed inspection and repair work

basic strategy of Biomedical equipment maintenance

The different approaches: reactive, preventive and predictive maintenance. There are three basic strategies for equipment maintenance, and understanding these approaches is of particular value with something as critical as medical device management

types of biomedical equipment maintenance

There are different types of medical equipment maintenance management:

- 1.reactive maintenance,
- 2.proactive, and
- 3.predictive maintenance.

Maintenance Requirements

1. Hard-time maintenance requirements:
2. Condition-monitoring maintenance requirements:
3. On-condition maintenance requirements

servicing tools and devices of biomedical equipment

Activity monitoring devices.

Axial-torsional testing systems.

Opto-electronic electrogoniometers.

Patient monitoring testing devices.

Polygraph recorders.

Torsiometers.

Two-point discriminators.

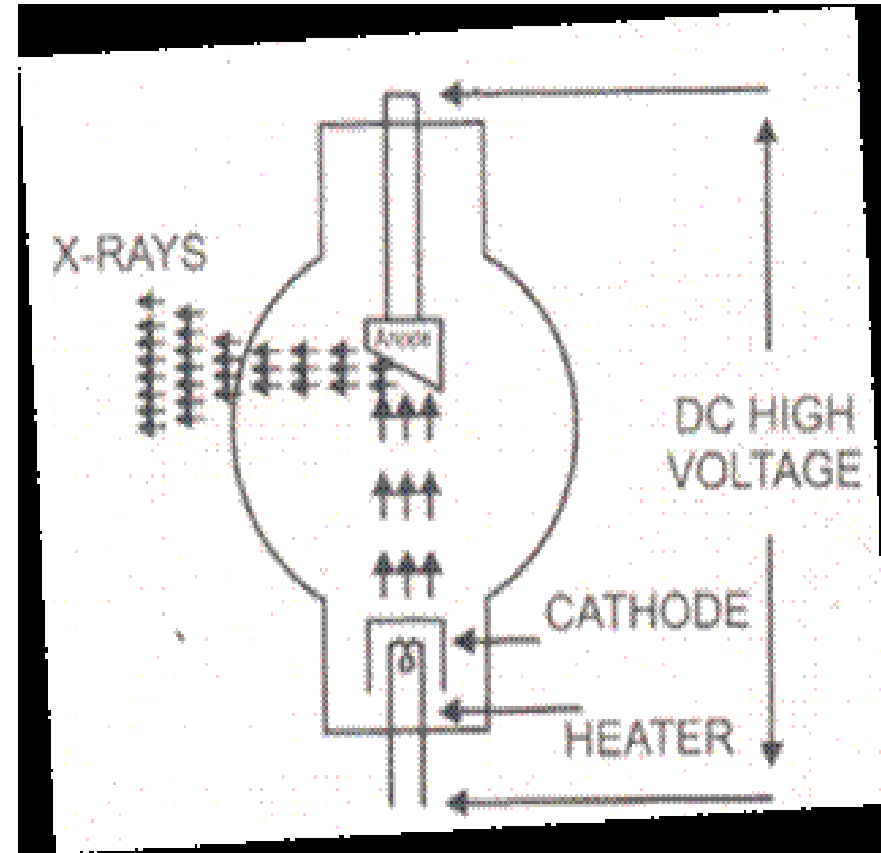
- Understand Radiology and Imaging Equipment

X-RAYS

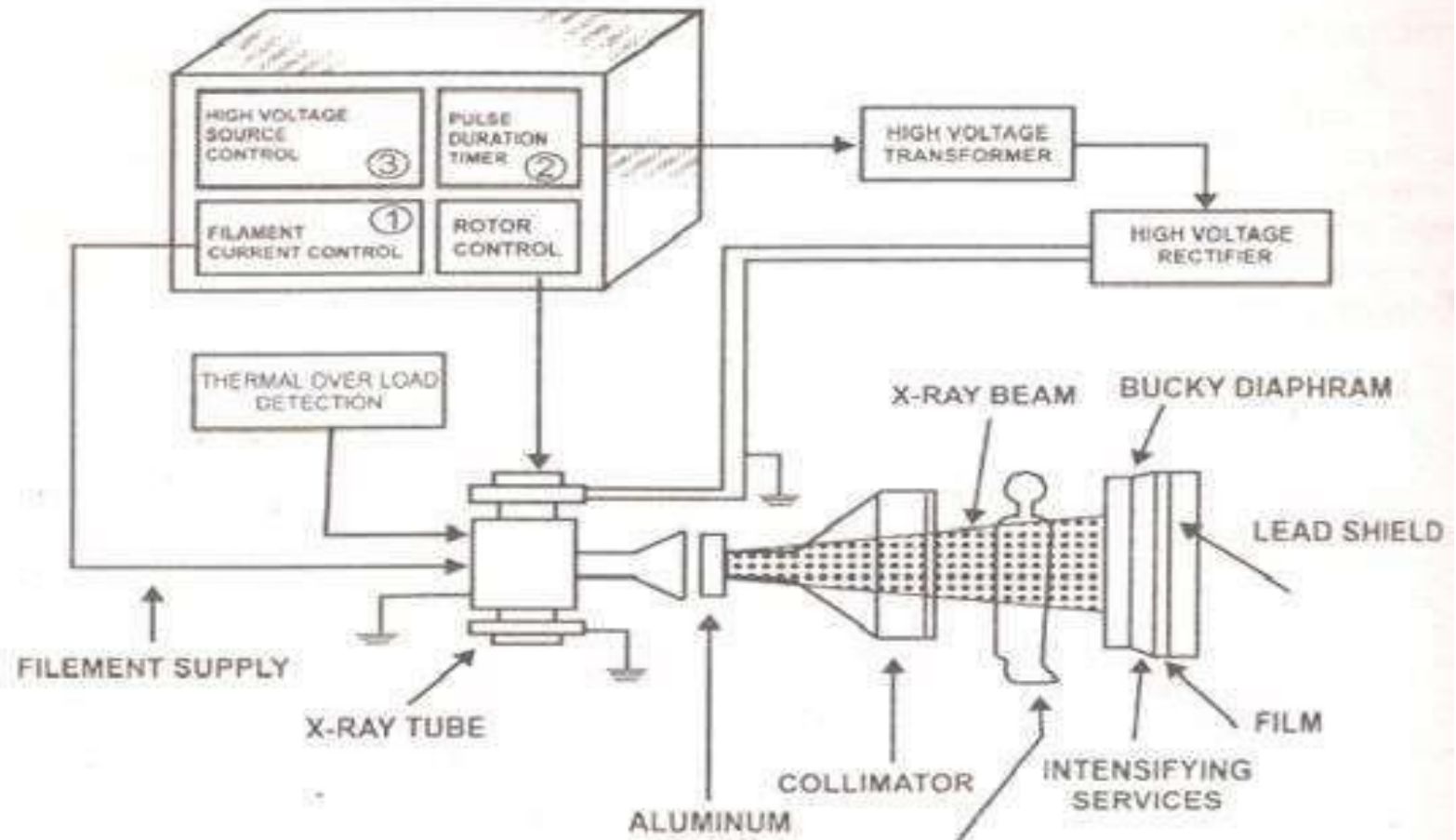
- ❑ The frequency of x-rays is approximately 10^{16} Hz and its wavelength is approximately 0.01 to 10 nanometer.
- ❑ It consists of a high vacuum tube with a heater, cathode and anode, vacuum tube, a large DC voltage is used between cathode and anode of x-ray tube.

HOW IT PRODUCED

- ❑ When heater is on and very high anode to cathode voltage is applied the electron emits from cathode and travel toward the anode with very high Velocity.
- ❑ This beam of electron strike the metal anode such speed that new rays are made from the slanting surface of the anode.
- ❑ These rays are x-rays, seem to bounce sideways out through the well of the tube.



BLOCK DIAGRAM



Magnetic resonance imaging (MRI)



- ❑ Magnetic resonance imaging (MRI) makes use of the magnetic properties of certain atomic nuclei.
- ❑ The hydrogen nuclei behave like compass needles that are partially aligned by a strong magnetic field in the scanner.
- ❑ MRI does not involve radioactivity or ionising radiation. The frequencies used (typically 40-130 MHz) are in the normal radiofrequency range, and there are no adverse health effects.

Advantages:

- ❑ MRI is particularly useful for the scanning and detection of abnormalities in soft tissue structures in the body
- ❑ There is no involvement of any kind of radiations in the MRI.
- ❑ MRI scan can provide information about the blood circulation throughout the body and blood vessels.

Disadvantages:

- ❑ MRI scan is done in an enclosed space, i.e. fearful of being in a closely enclosed surface, are facing problems with MRI to be done.
- ❑ MRI scans involve really loud noises while processing because they involve a really high amount of electric current supply.
- ❑ MRI scanners are usually expensive.

COMPUTERIZED TOMOGRAPHY

- A 'computerized tomography' (CT) uses a computer that takes data from several X-ray images of structures inside a human's or animal's body and converts them into pictures on a monitor.

WORKING

- ❑ A CT scanner emits a series of narrow beams through the human body as it moves through an arc.
- ❑ Inside the CT scanner there is an X-ray detector which can see hundreds of different levels of density. It can see tissues inside a solid organ. This data is transmitted to a computer, which builds up a 3D cross-sectional picture of the part of the body and displays it on the screen.

ADVANTAGES

- ❑ Quick and painless
- ❑ Can help diagnose and guide treatment for a wider range of conditions than plain X-rays
- ❑ Can detect or exclude the presence of more serious problems

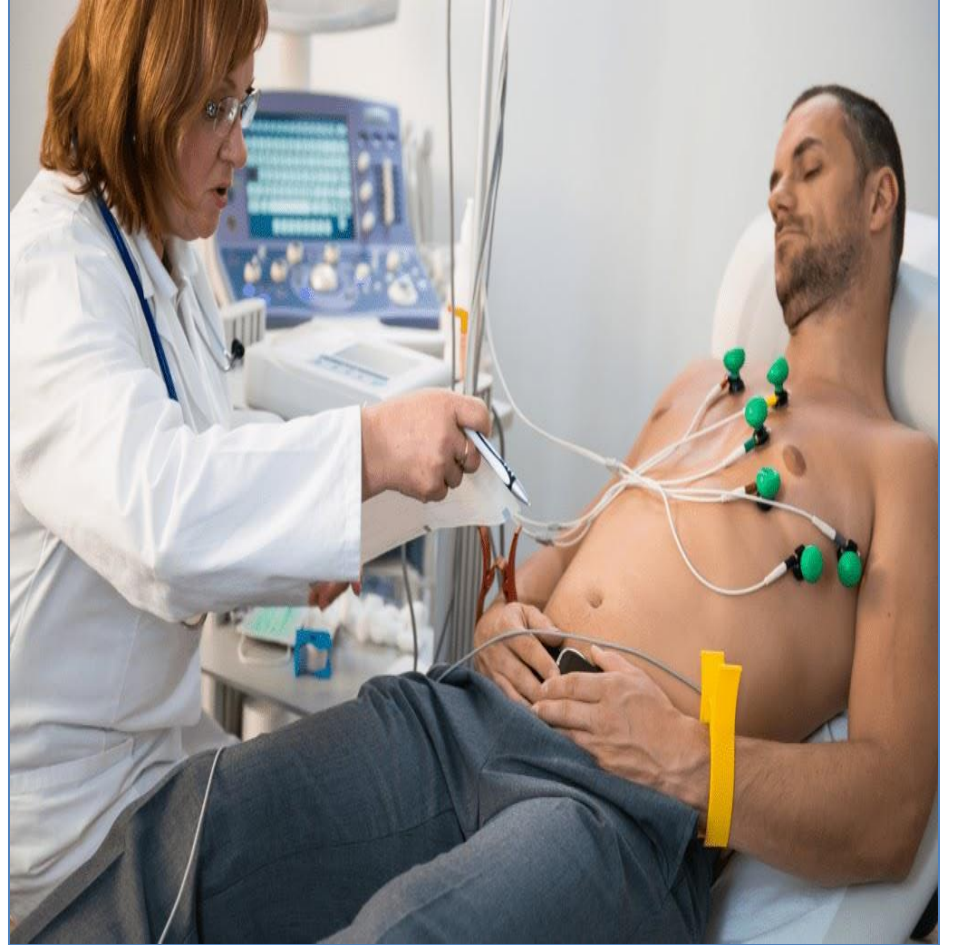
DISADVANTAGES

- ❑ Small increased risk of cancer in future from exposure to ionising radiation.
- ❑ Uses higher doses of radiation, so the risks (while still small) are in general greater than other imaging types



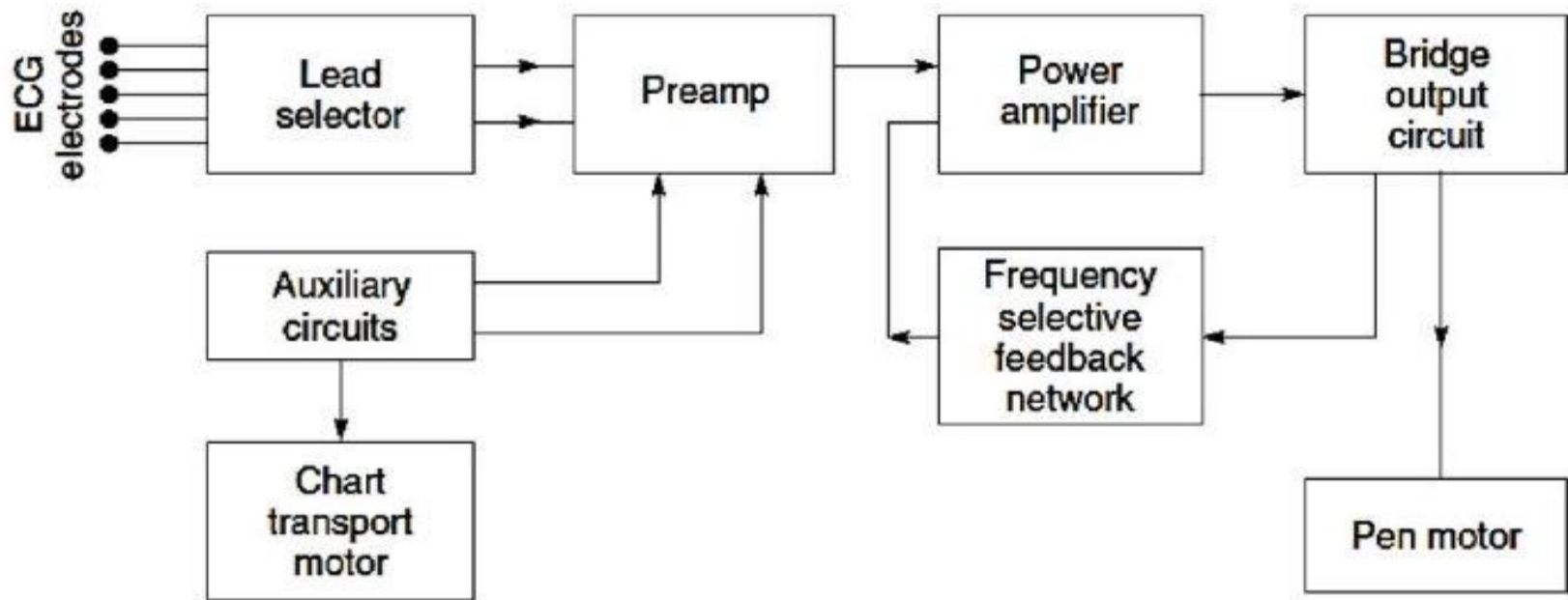
ইসিজি মেশিনের ব্যবহার

কোন হাটের রোগী বা কোন মুমূর্ষু রোগীর হাটের কার্যকারিতা ও হাটের বর্তমান অবস্থা পর্যবেক্ষণ করে হাটের রোগ নির্ণয়ের জন্য ইসিজি মেশিন ব্যবহার করা হয়।



ইসিজি মেশিনের গঠন

ECG Block Diagram



চিত্রঃ ইসিজি মেশিনের ব্লক ডায়াগ্রাম

ইসিজি মেশিন এর ত্রুটি ও সমস্যাাবলি

১. ইলেক্ট্রোড সংযোগ সমস্যা, প্রাথমিক ব্যর্থতার পয়েন্টগুলির মধ্যে একটি হল দুর্বল ইলেক্ট্রোড যোগাযোগ।
২. তারের এবং লিড সংযোগ ব্যর্থতা।
৩. সংকেত গ্রহণ এবং প্রক্রিয়াকরণ সমস্যা।
৪. সফটওয়্যার সমস্যা এবং ক্রমান্বয়ন ত্রুটি।
৫. পাওয়ার সাপ্লাই এবং ব্যাটারির সমস্যা।

ইসিজি মেশিন এর ত্রুটি ও সমস্যাগুলির সমাধান

১. ইলেক্ট্রোড সংযোগ সমস্যা, প্রাথমিক ব্যর্থতার পয়েন্টগুলির মধ্যে একটি হল দুর্বল ইলেক্ট্রোড যোগাযোগ।
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ইসিজি মেশিন এর রক্ষণাবেক্ষন

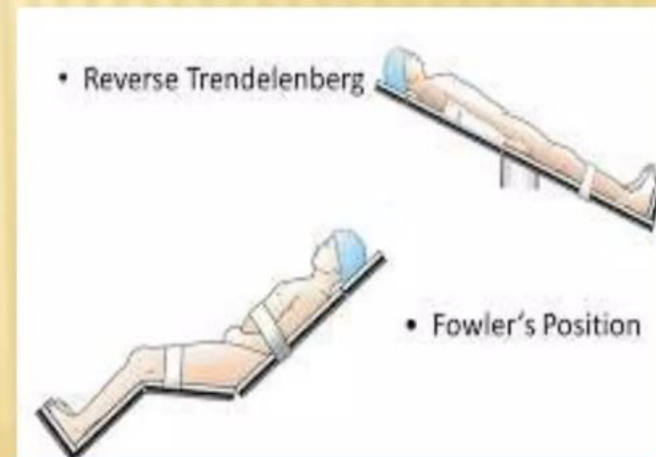
- ইসিজি রেকর্ডিং প্রতিটি দিন পরে ইলেকট্রোড পরিষ্কার রাখুন। তামার খাদ থেকে তৈরি ইলেকট্রোডের জং থাকলে, জং দাগটি সূক্ষ্ম স্যান্ডপেপার দিয়ে নিশ্চিহ্ন করা যেতে পারে এবং তারপরে পৃষ্ঠের স্থিতিশীল ফিল্ম গঠনের জন্য রাতারাতি লবণাক্ততার মধ্যে নিমজ্জিত করা যেতে পারে। রৌপ্য-ধাতুপট্টাবৃত ইলেকট্রোডটি জল দিয়ে ধুয়ে ফেলা যায় এবং রৌপ্য প্লেট স্তরটি খনন করা এড়াতে শুকনো শুকিয়ে যায়।
- সীসা তারের মূল তারের বা ঢাল ভাঙ্গা এবং ক্ষতি সহজ, উভয় প্রান্তে বিশেষত সংযুক্ত কাছাকাছি, টানা বা পাকানো না। সংগ্রহ করার সময়, এটি অত্যধিক বিকৃতি বা তীক্ষ্ণ কোণ ভাঁজ এড়ানোর জন্য বড় ব্যাস রিং বা স্থগিতাদেশে তৈরি করা উচিত।
- এসি এবং ডিসি ইসিজি মেশিন ব্যাটারি জীবন দীর্ঘতর করার সময় চার্জ করা উচিত।
- ইসিজি মেশিন উচ্চ তাপমাত্রা, সূর্য, আর্দ্রতা, ধুলো বা প্রভাব এড়ানো উচিত, এবং ধুলো কভার আবরণ।
- ধুলো অপসারণ, dehumidification এবং পরিদর্শন জন্য প্রতি ছয় মাস কভার খুলুন। মেশিনের ভিতরের শুষ্কতা নিশ্চিত করার জন্য বোর্ড থেকে ধুলোটি সরান, আর্দ্রতা বা ধূলিকণা দ্বারা সৃষ্ট ছোট সার্কিটগুলি এড়িয়ে চলুন এবং বোর্ডকে ক্ষতিকর করুন।
- বৈদ্যুতিক যন্ত্র রক্ষণাবেক্ষণ বিভাগ দ্বারা ইলেক্ট্রোকার্ডিওগ্রাফের নিয়মিত নিয়মিত পরীক্ষা করা হয়। গরম কলম রেকর্ডিং ইলেকট্রোকার্ডিওগ্রাফ রেকর্ডিং কাগজ এবং কাগজ ফিড গতি তাপ সংবেদনশীলতা অনুযায়ী গরম কলম চাপ এবং তাপমাত্রা সামঞ্জস্য করা উচিত। Electrocardiographs প্রায়ই ব্যবহারে হস্তনির্মিত এবং ব্যাঘাত আছে। গুরুতর ক্ষেত্রে, তারা ইসিজি স্বাভাবিক ট্রেস প্রভাবিত করবে এবং সময় চেক করা উচিত।

What are the equipment in OT?

- In the operating theatre, various equipment is employed, including surgical tables, lighting systems, an aesthesia machines, monitoring devices, endoscopic instruments, microscopes, and electrosurgical units.

SPECIAL FEATURES

- Operation table is used for general surgery and other certain procedures. It provides smooth, easy and accurate positioning.
- It is fully maneuverable by finger tip operated feather touch keys on a remote control hand switch.
- Unique, sensor controlled leveling for Lateral and Trendelenberg positions.
- Movement is controlled by high pressure electro-hydraulic system to achieve smooth and efficient operation, without the slightest jerk from start to the end.
- The manifold has flow control valves for adjusting the desired speed of the table movement to high accuracy.
- Hydraulic motor pump with long operating life is fitted with anti-vibration mountings and auto thermal cut-off.



MANUAL ADJUSTMENTS

- Head section can be moved mechanically.
- Detachable for fixing neuro hand rest
- Table is mounted on castor wheels, its movement in the operation theatre is smooth
- Mechanical pedal brakes for firm and rigid locking of table.
- When brake is released, the table is free to move on its castors

IMPORTANCE OF PROPER POSITIONING

Why do we need proper positioning?

- To maintain patient's airway and avoid constriction or pressure on the chest cavity
- To maintain circulation
- To prevent nerve damage
- To provide adequate exposure of the operative site
- To provide comfort and safety to the patient



OT Light



The human eye is best adapted for vision in natural light.

Intense efforts have been taken to generate lighting systems which can emulate natural lighting.

The human eye works primarily in contrast to identify objects and to give them context. When contrast is lost, visual performance and hence human performance begins to fail.

Effective and successful performance within the operating theatre is enhanced by having lighting which does not cause visual, operational and environmental difficulties such as glare, shadowing or visual stress



Uses of OT Light

The ability to adjust these lighting levels and change their characteristics will enable theatre staff to be more effective.

Incorrect or poor lighting can impact on the patient, through poor performance and impaired effectiveness which may cause lengthened procedures through uncertainty or even errors.



Surgical lighting is vitally important within the operating theatre to allow those working to have a clear vision of the surgical site and working area, and able to rely on the performance of the lighting equipment.

Cont.

Lighting Selection

An important decision to be made when investing in theatre lights is whether each operating theatre will need identical lighting equipment or whether the lighting will need to be specific to surgical disciplines.



Selection Team

Healthcare professionals involved in the decision making include:

Surgeons: Those from different specialties will have different illumination needs.

Nurses and OT Assistants: They are more concerned about the maneuverability, adjustment ease and simplicity of changing light handles.

Biomedical Engineers: They will look into the technical specifications, quality of the product, the electrical supply, mounting and suspension of lights.

Architects & Engineers: They will look into aesthetics and structural aspects of the installation.

Purchase & Finance: They will negotiate and look into taxes and payments.

Cont.

Basic Objectives

There are three key areas under which decisions and priorities should be made when determining a suitable operating theatre light. These are:

Adjustability: The design of the lighting unit and how it can adapt to meet individual requirements.

Brightness: The amount of light delivered by a source in order to illuminate a specific surgical area.

Control: Selection of a good design and an appropriate light source will help the system integrate into the operating theatre environment. However, flexibility and adjustability in the lighting system (amount of light and spread of light) will accommodate a wider range of tasks and activities.

Each of these elements will have an influence on the purchasing decisions for operating theatre lighting.

Troubleshooting of OT Light

High-Intensity Discharge (HID) Lighting

Gas-discharge lamps generate light by sending an electrical discharge through ionized gas. High-Intensity discharge (HID) lights are a type of electrical gas-discharge that use an electric arc to produce intense light.

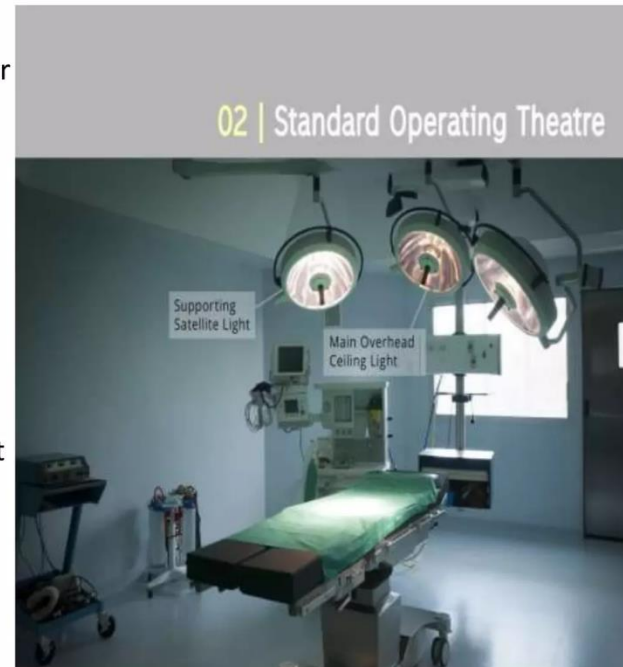
REQUIREMENTS FOR SURGICAL LIGHTS

- Surgical light requirements vary depending on the type, brand, and model of the lighting system.
- The brightness of a surgical light head is measured in Lux and typically does not exceed 160,000 Lux.
- The approximate dimensions are 400-700mm for a light head diameter and the approximate weight is 45kg. The weight can vary depending on the number of light heads attached to the system.
- The lifespan of a surgical light is measured in its L70 value, which is how long the light will last until its brightness is 70% of its original value.
- Today's surgical lights typically last between 40,000 to 60,000 hours of use.

Design of OT Light

Lighting Design

- Operating theatre lights are designed in single and multiple light heads which can be fixed in different ways within the operating theatre, for instance all, ceiling, track mounted or a floor standing version with a mobile base.
- Major operating lights should always be supplied as a **“main”** and **“satellite”** pair, as their use in combination is the major tool in **reducing shadow** from the surgical team.
- Single lamps, used in isolation may not provide the required light output desired for a surgical procedure.



What Are Electrolyte??

- Electrolytes are positively and negatively charged molecules called ions, that are found within the body's cells and extracellular fluids, including blood plasma.

- Electrolytes play multiple roles in the maintenance of body functions:

- 1-They sustain osmotic pressure which control fluids distribution in the body (*related to sodium level*).

- What is the principle of an electrolyte analyzer machine?
- Electrolyte analyzers typically employ electrochemical sensors, such as ion-selective electrodes (ISEs), to detect specific ions in the sample. These sensors work based on the principles of electrochemistry and ion exchange.

- Water and electrolytes are administered as oral rehydration solution (ORS) to replace existing losses (the deficit is replaced quickly over 3-4 hours) Maintenance phase: This includes both replacement of ongoing fluid and electrolyte losses and adequate dietary intake.

ELECTROLYTE PANEL

Electrolyte analyzers measure electrolyte concentrations in body fluids - typically whole blood, plasma, serum, or urine specimens.

Electrolytes typically measured by an Electrolyte Analyzer are called the “Electrolyte Panel” which consists of:

- Sodium (Na^+)
- Potassium (K^+)
- Chloride (Cl^-)
- Bicarbonate (HCO_3^-)

What is the instrument for respiratory?

- In a spirometry test, while you are sitting, you breathe into a mouthpiece that is connected to an instrument called a spirometer. The spirometer records the amount and the rate of air that you breathe in and out over a period of time. When standing, some numbers might be slightly different.

Maintenance of Nebulizer Machine

- Your nebulizer will also need a thorough cleaning once a week. Soak the mouthpiece or mask, top piece, and medicine cup in a white vinegar and water solution for 30 minutes, or as recommended by your device manufacturer. After 30 minutes, rinse and air-dry in a cool, dry place.

- It can be time-consuming to clean and maintain your machine, so you'll need to build this into your routine. It's important to clean and dry your nebuliser thoroughly every day if you use one regularly. You should not wash the tubing that connects the nebuliser to the chamber – only the mask and chamber need washing.

Troubleshooting of Nebulizer

- If the nebulizer compressor is not working, check your power source. Make sure the plug is firmly inserted in the outlet. If you have a portable nebulizer, check the batteries to make sure they have a charge or if they need to be replaced. Nebulizers rarely have issues with their compressors.

Nebulizer Machine



What are the complications of Nebulisation?

- The most common side effects of nebulizer treatment are rapid heartbeat, jitteriness and anxiety. Less frequent side effects may include headache, nausea, vomiting or throat irritation. Serious reactions to nebulizer treatment are also possible and should be immediately reported to the prescribing physician.

CPAP



A Gentler Mode of Respiratory Support



CPAP Machine:

An ideal CPAP delivery system consists of:

- A continuous supply of warm, humidified, blended gases at a flow rate of 2-3 times the infant minute ventilation.
- A device to connect CPAP circuit to infants airway. (patient interface)
- Means of creating a positive pressure in CPAP circuit.



What is the maintenance on a CPAP machine?

How Often You Should Clean Your CPAP Equipment

CPAP Components

Frequency of Cleaning

Hose

Dry after each use and clean every week

Mask cushions

After each use

Nose pillows

After each use

Mask

Every two days

- Most CPAP machines have filters that should be replaced on a regular basis. Disposable filters are the most common and should be replaced every two weeks, while reusable filters should be washed every two weeks and replaced every three months.

CPAP Troubleshooting

Problem

Causes

**Mask leaks, skin irritation,
pressure sores/blisters**

**Straps too tight or too
loose Worn-out mask Dirty
mask**

**Dry nose or throat, nasal
congestion, epistaxis
(Bloody Nose)**

Dry air

Dry mouth

Sleeping with mouth open

Dry irritated eyes

**Mask leaks. Mask is too
tight.**



How to Maintain your **CPAP/BiPAP** Machine?



Why is it Important to Maintain BiPAP Machines?

- It is essential to clean and maintain the machines for hygiene because there is a higher chance of collecting dust, oil, and debris inside the mask, and it will create a home for bacteria, germs, and congestion. As a result, you will get sick, and your life may be in danger.
- If someone is suffering from sleep apnea, you should consult with your doctor and tell them about your health conditions. Conditions worsen because airway pathogens can cause illness, sinus, and pneumonia. Ultimately, daily cleaning will save you the cost of replacing the machine and make you healthy.

How can you Maintain a BiPAP Machine?

- ❖ The medical equipment provider suggests making a habit of cleaning equipment for health. It would help if you cleaned your mask daily; filters, tubes, and water chambers. It is a myth that excessive cleaning can damage equipment, but it does not.
- ❖ We provide some direction to clean equipment daily or weekly.
- ❖ Daily Cleaning
- ❖ Remove the empty humidifier water chamber so the water can't enter the machine.
- ❖ Then allow the water chamber for air dry to clean the surface thoroughly.
- ❖ Now clean the mask and headgear with warm soap water. Repeat the process only with warm water.
- ❖ Then place it completely dry.

Troubleshooting of BiPAP machine

- If the issue persists, it may be necessary to replace the cushion or try a different mask. Another issue that can arise with CPAP and BiPAP machines is difficulty breathing or discomfort while using the machine. This can be caused by a poorly fitting mask, a high air pressure setting, or a clogged air filter.

Routine maintenance of spirometer

- If you have an incentive spirometer for home use, it's a good idea to clean it daily. Detach the mouthpiece from the base of the device and clean it with clean running water and antibacterial soap for about 20 seconds. Then wash the rest of the spirometer with water and soap.

Preventive maintenance of spirometer

- Preventive maintenance tests include a physical inspection of the device, electrical safety tests, internal cleaning and calibration. Unless you are an expert in the field, it is always advisable to rely on a professional to carry out all the necessary operations.

What is an ICU ventilator?

A breathing machine called a ventilator or respirator may be used to help people have conditions or illnesses that make breathing on their own very hard. A ventilator is a machine that helps you breathe by pushing oxygen into your lungs and carbon dioxide from your body.

How will you take care of a ventilated patient in the ICU?

- a) Use aseptic technique.
- b) Provide frequent mouth care.
- c) Keep head of bed elevated 30 degrees.
- d) Consider use of subglottic secretion drainage endotracheal tube.
- e) Provide frequent mouth care with chlorhexidine.
- f) Stress ulcer prophylaxis.
- g) Support proper nutritional status.

Nursing monitoring should include:

- Review communications from the professional healthcare team.
- Check ventilator settings.
- Suction the patient as needed.
- Evaluate sedation and pain needs.
- Use techniques to avoid infection.
- Check and recheck the patency of the airway.
- Monitor vital signs for hemodynamic instability.

Troubleshooting of icu ventilator

Discontinuation of the central gas supply, malfunction of the air compressor, or empty gas cylinders. Connection failure (i.e. the operator forgets to connect the ventilator to the gas supply or there is a sizeable leak at the gas connection line).

ધન્યવાદ