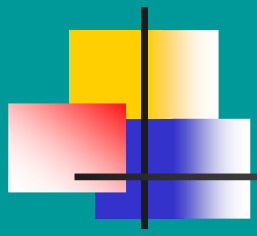


Electrical Safety
Causes of Electrical Accidents
Effects of Shock and Related Treatment

“The best safeguard against accidents is a genuine safety culture - awareness and constant vigilance on the part of all those involved, and the establishment of safety as a permanent and natural feature of organizational decision-making”.

IACS

Objectives

At the end of this module you should be able to:

1) State the main causes of Electrical Accidents
2) State work permits and procedures prior to commencing electrical work in enclosed spaces and hazardous areas
3) Describe / demonstrate the precautions before commencing work on electrical equipment.
4) Describe / demonstrate the safety precautions related to entering into and working in battery room.
5) Describe /demonstrate safe method to ensure the “Circuits” are “Dead” prior to touching conductors and terminals.
6) Describe /demonstrate safe method to measure current in a circuit and state the minimum “Shock Current”.
7) Explain how to respond in an emergency

Risk Management

The IMO defines risk as: “The combination of the frequency and the severity of the consequence.”

Risk thus has two components: likelihood of occurrence and severity of the consequences.

Risk Management

A hazard is a substance, situation or practice that has the potential to cause harm. Briefly, what we are concerned with, therefore, is:

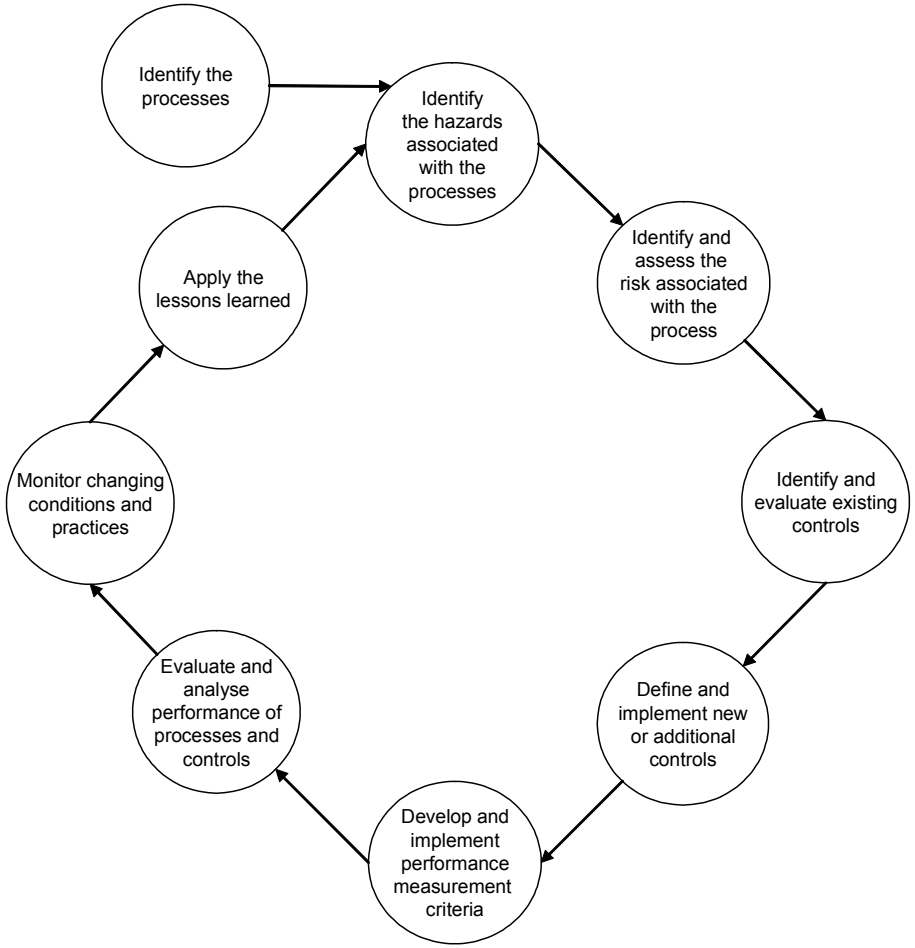
- The identification of hazards
- The assessment of the risks associated with those hazards
- The application of controls to reduce the risks that are deemed intolerable
- The monitoring of the effectiveness of the controls

Risk Management

The controls may be applied either to reduce the likelihood of occurrence of an adverse event, or to reduce the severity of the consequences. The risks we are concerned with are those which are reasonably foreseeable, and relate to:

- The health and safety of all those who are directly or indirectly involved in the activity, or who may be otherwise affected
- The property of the company and others
- The environment

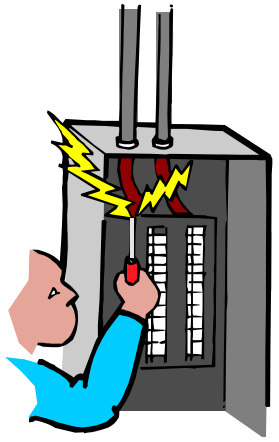
Risk Management



General Electrical Safety

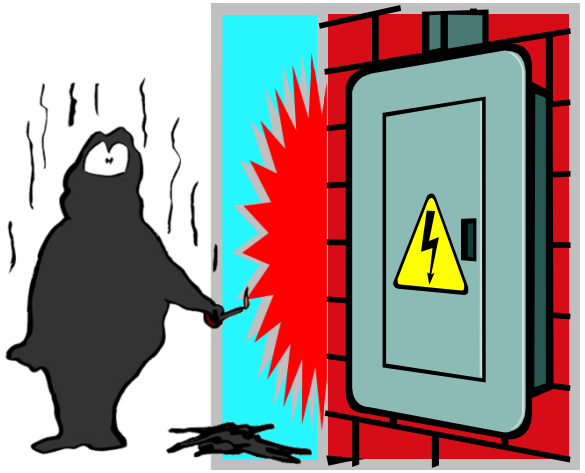
Electricity has long been recognized as a serious hazard in the workplace, exposing employees to possible dangers such as electrical shock, electrocution, fires, and explosions.

This module stresses on the basic aspects of safety in various locations and under varying conditions



Main Causes of Electrical Accidents

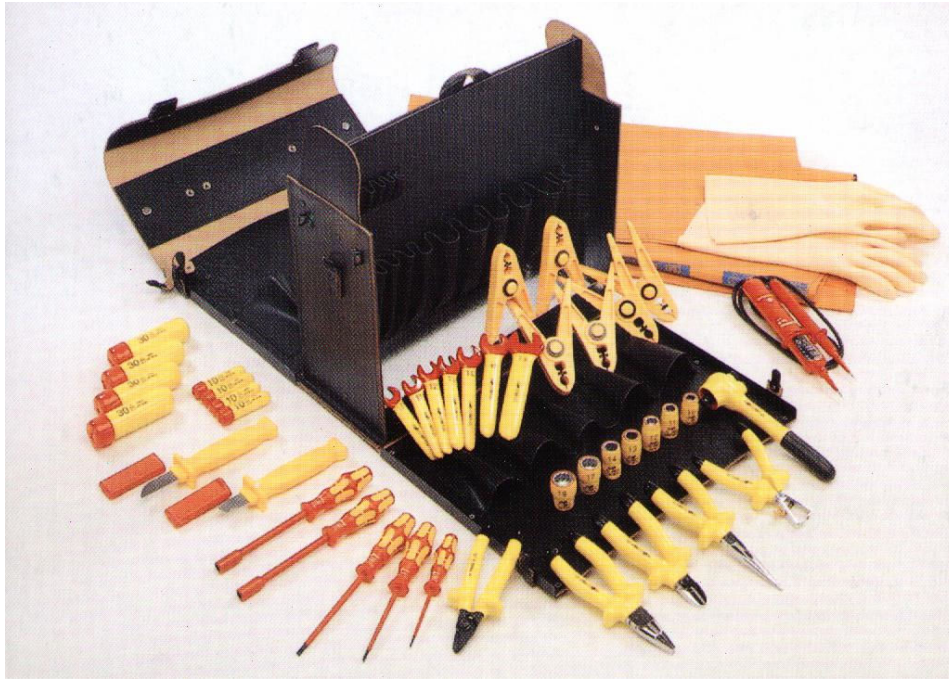
- Unsafe Acts
- Unsafe Equipment
- Hazardous Environments



Unsafe Acts

- Failure to de-energize, lockout and tagout hazards during maintenance, repair or inspections

- Use of defective and unsafe tools; the next picture depicts an example of good quality, certified tools.



Unsafe Acts

- Removing the third prong (ground pin) to make a 3-prong plug fit a 2-prong outlet
- Overloading outlets with too many appliances
- Using the attached electrical cord to raise or lower equipment

Unsafe Acts

- Failure to read and follow all safety signs, symbols and barriers
- Failure to use good housekeeping with respect to tools and work areas
- Not verifying power is off when making repairs (e.g., drilling into a 110-Volt a.c. line can kill)

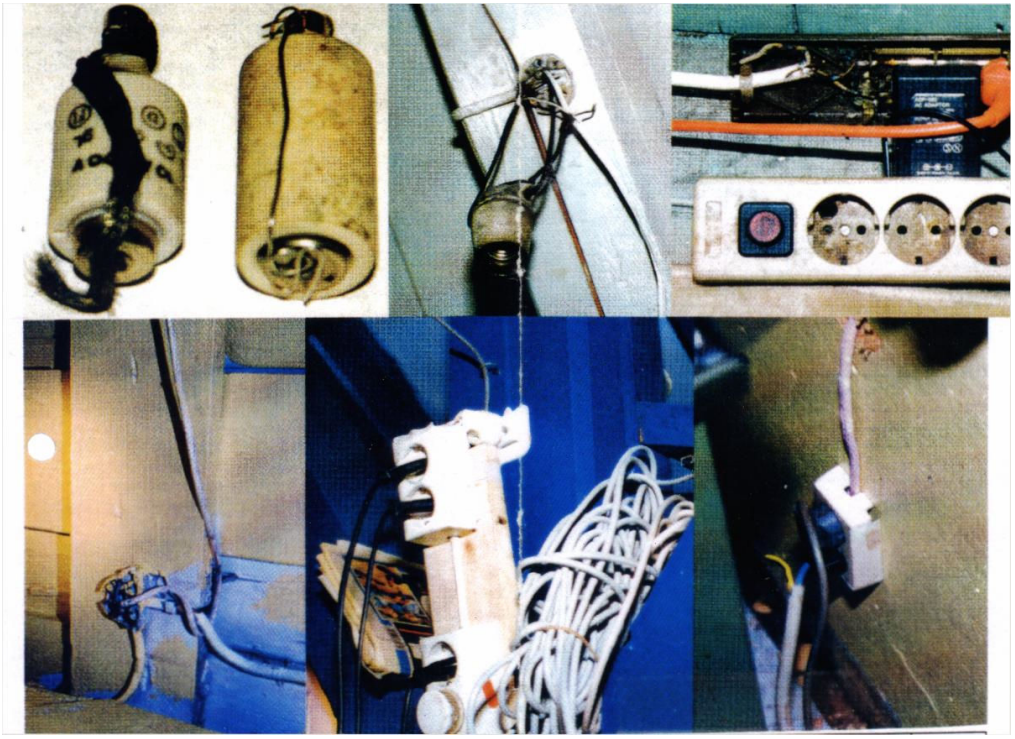
Avoid Unsafe Acts

- Refrain from using a knife to strip wires – use a wire-stripper which not only protects fingers but also prevents nicks in wires
- Safety goggles should be worn whenever power tools are used
- Ensure that proper wire gauge (based on the load is used)
- Replace wiring that shows signs of fraying or deterioration
- Never increase the capacity of the fuse or breaker in the circuit
- Use the proper protection, take precautions and plan ahead
- Never bypass safety to save money or time

Unsafe Equipment

- Un-inspected electrical tools
- Un-inspected portable extension cords
- Improper grounding (removal of third pin)
- Defective parts
- Overloaded outlets
- Faulty electric cords

Unsafe Equipment



Caution:

- ✓ Be extremely careful around unfamiliar equipment and areas.
- ✓ Inspect all equipment, cords, switches, and components prior to each use.

Avoid Unsafe Equipment

1. Use meters and test leads with double insulation, finger guards and non slip surface
2. Use meters with recessed input jacks and test leads with shrouded input connectors

Unsafe Environment

- Flammable fumes, combustible dust , or excess oxygen can be ignited by a spark. (*Use ventilation to minimize hazard*.)
- Poor housekeeping: blocked electrical boxes, flammable materials stored in equipment rooms, lack of proper hazard signs, excess clutter

Unsafe Environment

- Wet working conditions: Never work with electricity if you or the work area have been exposed to wet weather.
- Check your surroundings:
  - Make sure energized electrical parts cannot come in contact with you or anything that may come in contact with you.
  - Make sure there are no trip hazards.

Unsafe Environment

It is important to ensure proper ventilation when using volatile electro-cleaners, varnishes and paints having solvents as they are highly combustible. More often than not, they have very low ignition and evapouration temperatures. The compartment must have its fresh air supply and exhaust fans running satisfactorily as a fire of this nature is likely to spread rapidly if not kept under control.

The figure on the right is that of a non-sparking type of fan used in hazardous areas.

Unsafe Environment

Electrical fires are different than other fires.

1. Turn off the main power.
2. NEVER use water on an electrical fire. Water conducts electricity; throwing water on an electrical fire can cause also the fire to get larger.
3. If the fire can be put out safely, use a proper fire extinguisher.

Electrical Work Permit

It is mandatory to obtain a work permit prior to carrying out any work on equipment that is supplied with voltages greater than 1000 volts; in fact most vessels insist on work permits for electrical equipment that operate at even less than 1000 volts.

Past experience indicates that about 90% of electrical accidents can be avoided if proper safety precautions are taken before commencing any work. Some of the factors that contribute to accidents are:

- Lackadaisical attitude of supervisors;
- Dearth of knowledge;
- Over confidence or complacency; and
- Defective or sub-standard safety appliances

Electrical Work Permit

A permit of this nature has two copies - one original and the other, a carbon copy, signed by the responsible person. The permit is usually valid for only 24 hrs. After that it should renewed.

It generally the following sections.

1) The first section states the nature of the work to be done.
2) The second section declares where electrical isolation and earthing has been applied and where danger notices / tags are displayed. The permit is signed either by Electrical Officer or Chief Engineer.
3) In the third section the person responsible for the work (as named in the first section) signs to declare that he is satisfied with the safety precautions and that the HV circuit has been isolated and earthed.
4) Section four relates to the suspension or completion of the designated work and cancellation of the permit with the signature from the authorizing officer.

Live Circuits

Isolated Circuits

Electrical Work Permit

Note:

Some companies may also require an associated Electrical Isolation Certificate to declare where exactly circuit isolation and earthing has been applied before an EPTW can be authorized. A Sanction to Test safety certificate may also be required when an electrical test e.g. electrical insulation test, is to be applied. This is necessary as circuit earth has to be removed during such testing.

Before You Work on Electrical Equipment...

1) Isolate the system by safely opening the breaker and removing the fuses.
2) Prove that the equipment is dead by using proper test equipment.
3) Earth the equipment.
4) Make a safe access to equipment.
5) Use hand gloves, safety shoes and safety goggles.
6) Use tools with insulated handles.
7) Follow the procedure of work as specified in the equipment manuals.
8) Take measures to minimise the hazards from loose tools and dirty rags.
9) Check your tools for accountability.

Want to avoid shocks?

Preparing for Maintenance?

Safety Measures to Ensure that Circuits are Dead

- ✓ Confirm that circuits are dead (by using a voltage tester) before touching conductors and terminals.
- ✓ Never rely totally on switches, etc, as sometimes they may be defective or could have been wired or labelled wrongly, such that when indicating ‘Off’, they could actually be ‘On’ thus completing the power supply to the circuit.

Safety Measures to Ensure that Circuits are Dead

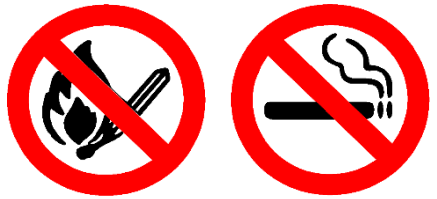
Live Line Test: Before earthing down any circuit or equipment, declared in an Electrical Work Permit, it must be tested and proved dead after disconnection and isolation. This can be very easily done by using an approved live line tester. Check the instrument used for testing (to ensure that it is working); this can be done by connecting the live line tester to a known HV source. This live line tester can be either external battery operated type or having internal self-test facility. Two people should always accompany each other while working on HV circuits or equipment. next check the equipment which has been made dead (for any presence of electricity); finally check the instrument on a live circuit so as to ensure that it is still working.

Read More

Safety Measures to Ensure that Circuits are Dead

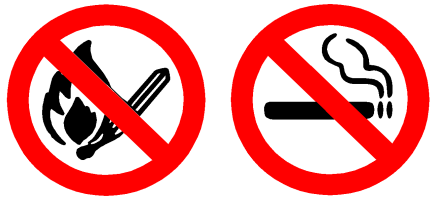
Switch off and lock all supplies[1], remove fuses (and store them in a safe place), and display warning notices before removing covers of equipment for maintenance. Refrain from asking others to do this; do this yourself as you are going to work on the equipment.

[1] *Proper and foolproof electrical locking would not merely mean switching off the supply by operating the isolation switch / switch fuse handle but by removing the fuses or by mechanically locking the handle in the "Off" position*.



Safety in a Battery Compartment

- Handle all types of batteries with care.
- Wear protective clothing, such as a rubber apron and rubber gloves when working with batteries. Electrolyte will destroy everyday clothing such as overalls / boiler suits.
- Wear chemical splash-proof safety glasses when maintaining batteries.
- Take care to prevent spillage of electrolyte especially when topping up cells.
- Batteries with a liquid electrolyte should always be transported in the upright position to avoid spillage of electrolyte.



Safety in a Battery Compartment

- When electrolyte is being prepared, the concentrated sulphuric acid must be added *slowly or trickled into* the distilled water. If distilled water is added to the acid, the heat generated may cause evolution of steam, spattering acid all over the place!
- Use carrying straps when transporting batteries.
- Never short the terminals of a battery (also avoid wearing watches and jewellery).
- Do not exchange battery tools (including hydrometers) between lead-acid batteries and nickel-cadmium batteries.
- Never install alkaline and lead-acid batteries in the same compartment.

Read More

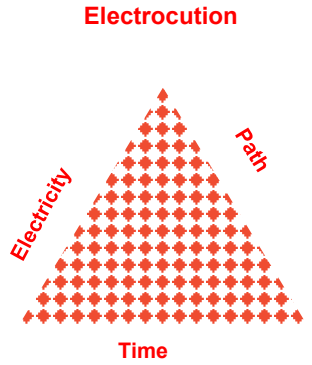
Electric Shock Currents and their Physiological Effects

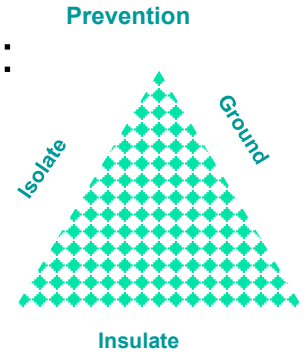
The severity of the shock received when a person becomes a part of an electric circuit is affected by three primary factors:

- The amount of current flowing through the body
- The path of the current through the body
- The length of time the body is in the circuit.

Other factors that may affect the severity of shock are:

- Frequency of the current;
- Phase of the heart cycle when shock occurs
- General health of the person.





Electric Shock Currents and their Physiological Effects

Microshock

Microshock describes an internal shock that may occur as a consequence of certain medical diagnostic or surgical procedures in which electrically operated sensors are introduced into the human body. The effective current ranges from 10 to 100μA.

Macroshock

Macroshock describes simultaneous contact between the body's surface and two electrical conductors at different potentials, and the physiological consequences of this contact.

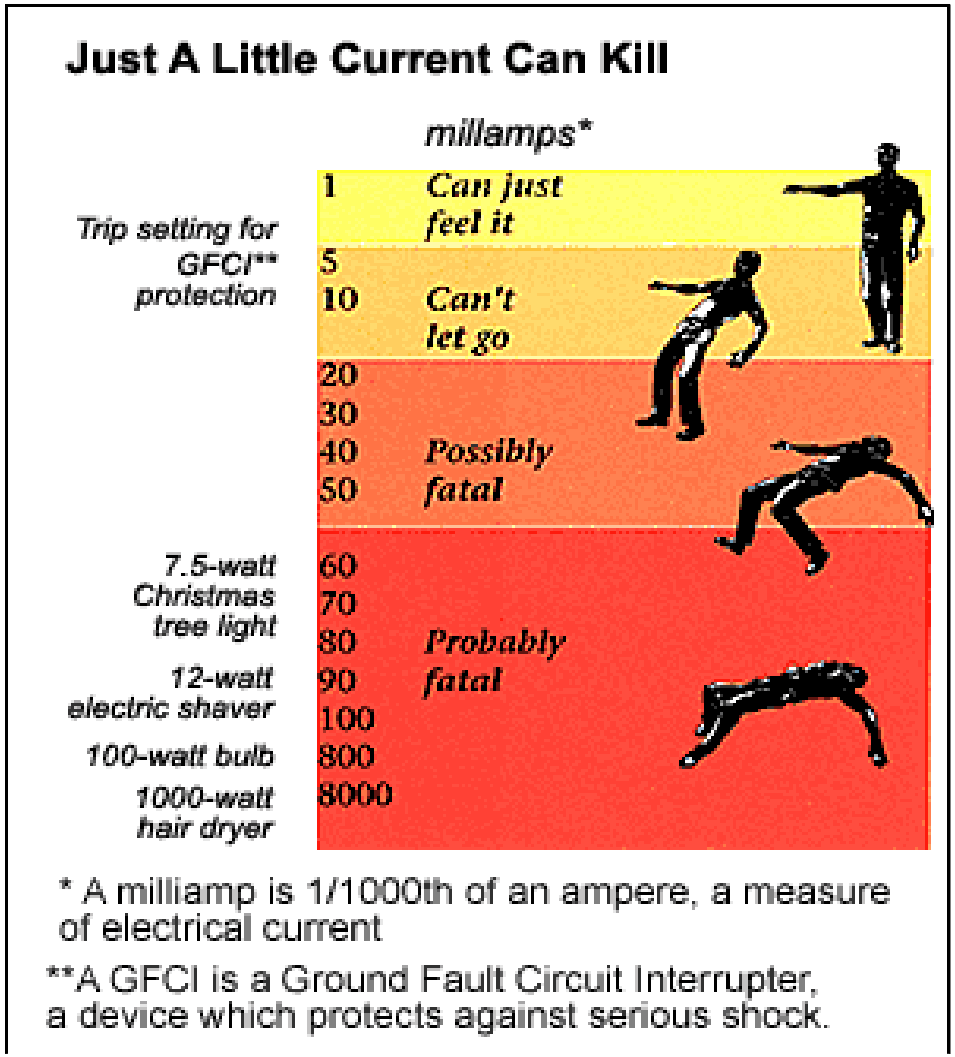
In the case of females, these values could be lower by 30% to 35%

Electric Shock Currents and their Physiological Effects

Current Level	Effect on the Victim
1 mA	Sensation that shock is occurring
5 mA	Upper limit of safe or harmless range
10 to 20 mA	Let-go threshold – the victim cannot shake loose from the source of shock and perspires
30 to 40 mA	Sustained muscle contraction and cramping
50 to 70 mA	Extreme pain, physical exhaustion, fainting, irreversible nerve damage; possibility of ventricular fibrillation (shocking of the heart into a useless flutter); respiratory arrest with possible asphyxiation
100 mA	Ventricular fibrillation (of the heart) and death if the current passes through the body trunk
>100 mA	Fibrillation, amnesia (memory loss), burns, severe electrolysis at contact sites
>5A	Little likelihood of survival

Read More

Electric Shock Currents and their Physiological Effects



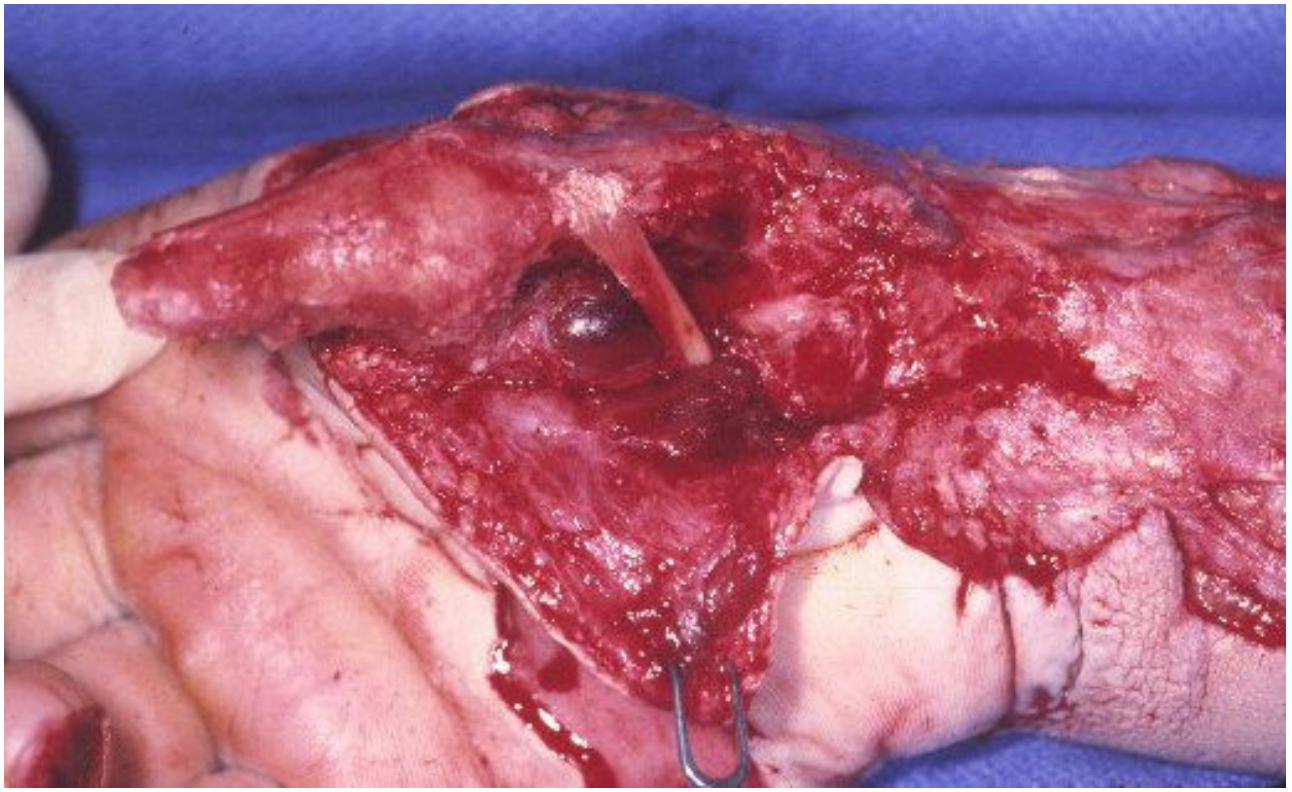
Electric Shock Currents and their Physiological Effects

Electrical Burns

- Heating when electricity passes through the body
  - "Entry" and "exit" wounds caused by electrical heating of the skin, because higher resistance of the skin results in heat generation (I^2R)
- Electrical arcing (arc burns are often caused by molten metal)
- Contact with electrically heated surfaces
- Electricity-ignited fires

The next 3 slides are graphic in nature – view them at your discretion

Yes No



Arm with third degree burn from high-voltage line.

Electrical burn on hand and arm.

Electrical Emergencies

How to Respond

Electrical Emergencies

Protect Yourself:

- NEVER use your bare hands to free a victim frozen by electric shock!
- Do *not* touch the victim- he or she may be energized.
- Do *not* use a conductive tool to free the person.

Electrical Emergencies

Call for help if the person:

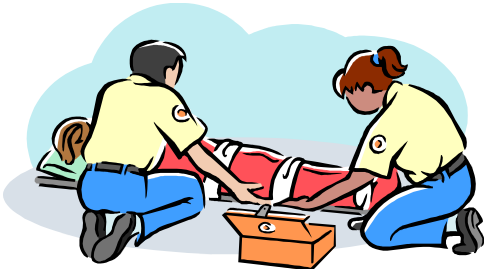
- Is obviously injured
- Has an altered mental status
- Has other obvious injuries
- *Or* at your discretion or that of the shock victim or supervisor

Electrical Emergencies

- **Check for:**
  - Pulse - If a person's heart has stopped, start CPR if you a trained.
  - Breathing - If the person isn't breathing, begin mouth to mouth resuscitation if you are trained.
- **Treat for Shock:**
  - Keep person lying down.
  - If unconscious, turn on side so fluids can drain.
  - Do not move the person if neck and spine injuries are possible.

Electrical Emergencies

- Stay with the patient until help arrives.
- Inform medical personnel of patient conditions.



Read
More
on First Aid

- Please read
  Marine Electrical Technology - Chapter 2 – Electrical Safety
  to learn more…

Thank You