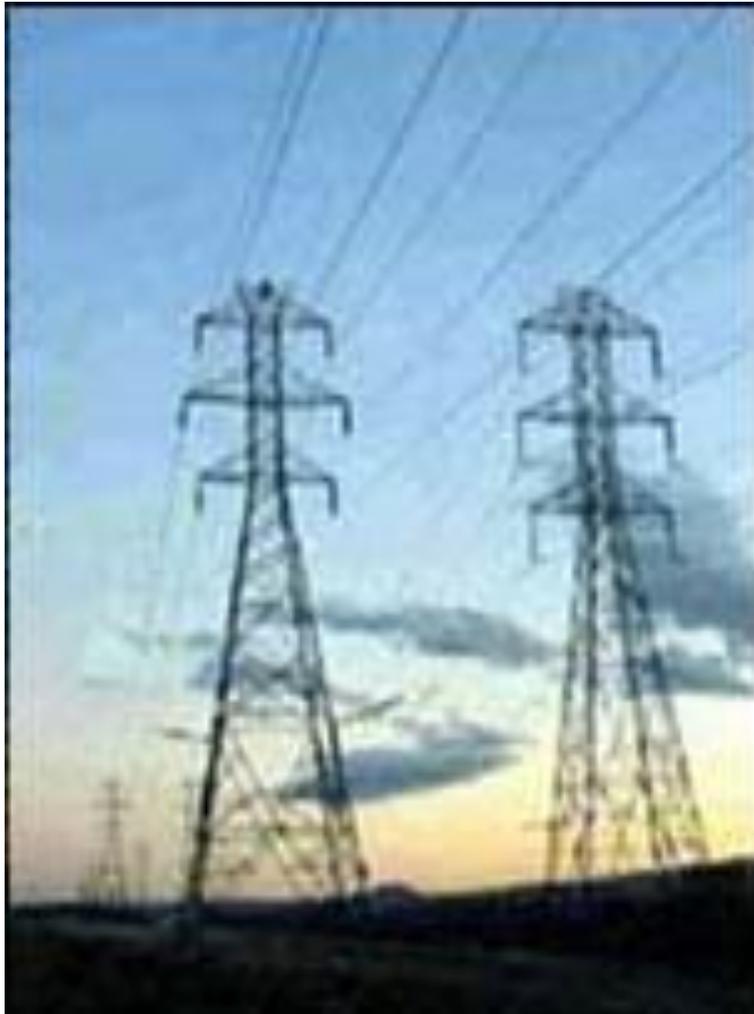


ELECTRICAL SAFETY



ELECTRICAL SAFETY



EM-385 SECTION 11

29 CFR 1926 Subpart K

NFPA-70 (NEC)

NFPA-70 E

NESC- National Electrical Safety Code

Governmental Safety Requirements 013526

**SAFETY REQUIREMENTS PROTECTION OF
PROPERTY PEOPLE**



ELECTRICAL SYSTEMS



ELECTRICAL VOLTAGES

HIGH OVER 15,000

MED 601-15,000

LOW 600 VOLTS AND LESS



Most voltages on job sites are <600 V

Higher voltages usually worked by lineman

WORKING WITH ELECTRICITY



Special training is required for work on electrical equipment.

ALL ELECTRICAL WORK SHALL COMPLY WITH APPLICABLE NATIONAL ELECTRICAL SAFETY CODE.(NESC), NATIONAL ELECTRIC CODE(NEC), OSHA AND USCG REGULATIONS

EM-385 Section 11.A.01 Electrical work shall be performed by Qualified Personnel with **verifiable credentials who are familiar with applicable code requirements. Verifiable credentials consist of State, National and/or Local Certifications or licenses that a Master or Journeyman Electrician may hold, depending on work being performed, and should be identified in the appropriate AHA**

QUALIFIED ELECTRICAL WORKERS



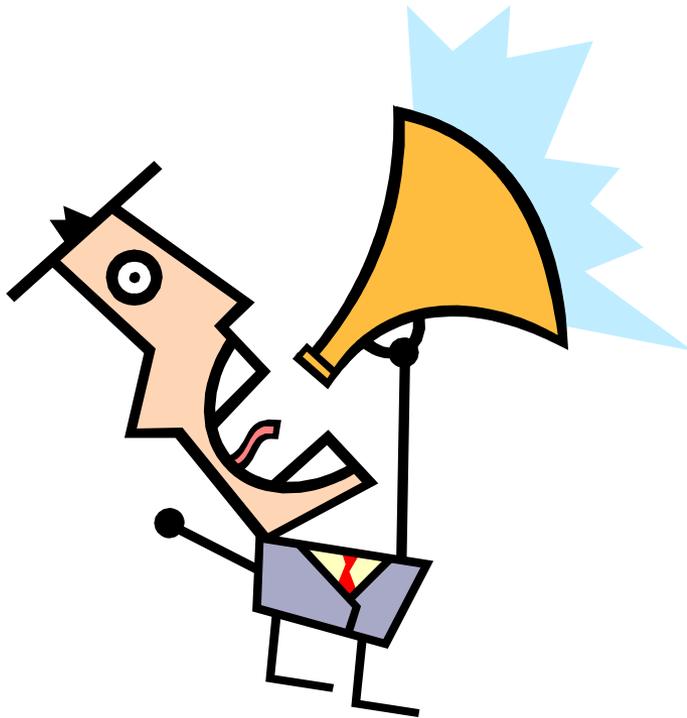
Qualified Person (Electrical): One who has received training in and has demonstrated skills and knowledge in the construction and operation of electrical equipment and installations and the hazards involved. This includes the skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment, to determine the nominal voltage of exposed live parts, the clearance distances and corresponding voltages to which the qualified person will be exposed.



ELECTRICAL SHOCK



DO YOU KNOW?



- Currents as small as 10 mA can paralyze or “freeze” muscles
 - A Person cannot release tool
 - Tool is held even more tightly,
 - resulting in longer exposure
 - to shocking current

An electric power drills uses 30 times as much current as what will kill.



ELECTRICAL BURNS



- **Most common shock-related, nonfatal injury**
- **Occurs when you touch electrical wiring or equipment that is improperly used or maintained**
- **Typically occurs on the hands**
- **Very serious injury that needs immediate attention**



FALLS



- **Electric shock can also cause indirect or secondary injuries**
- **Workers in elevated locations who experience a shock can fall, resulting in serious injury or death**

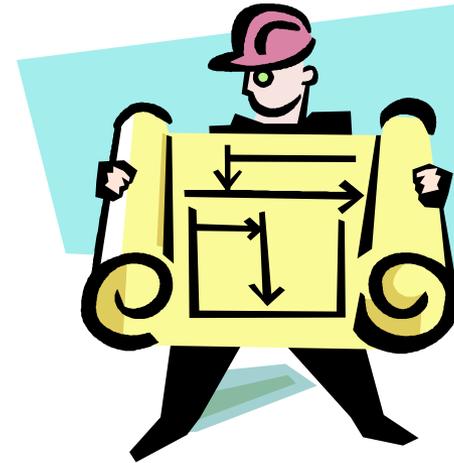


SAFE WORK PRACTICES



BEFORE STARTING WORK...

- A sketch of proposed temporary power distribution systems to be accepted by *GDA before* power installed.



Sketch shows the location, voltages, means of protection of all circuits, including receptacles, disconnecting means, grounding, GFCI's, and lighting circuits.

That is in COE
11.E



ISOLATION OF CIRCUITS



Working on energized circuits

**ENERGIZED WORK REQUIRES
COMMANDING OFFICER APPROVAL
AND A COMPLETED ENERGIZED
ELECTRICAL WORK PERMIT. SEE NFPA
70E**

**Lots of advance
notice needed
for this work!**



ISOLATION OF CIRCUITS



An AHA and written work procedures must be prepared for unusual or complicated work activities or any activity identified by the QUALIFIED PERSON.

11.B ARC FLASH

11.B.01 Whenever it is necessary to work on energized parts greater than 50 volts to ground, a risk/hazard analysis/arc flash hazard analysis will be conducted in accordance with NFPA 70E Either Appendices or Tables may be used to conduct analysis. The flash protection boundary, approach distances, hazard/risk category and PPE requirements shall all be identified. This AHA is separate, distinct and in addition to the AHA required in Section 01.

TEMPORARY ELECTRICAL POWER

Yep, right here in 11.A.03 and the ground resistance to be 25 Ohms or less

- **Temporary electrical & devices are to be checked for polarity, ground continuity & resistance before used & modification. GFCI shall be tested monthly & recorded & copy furnished to the GDA**



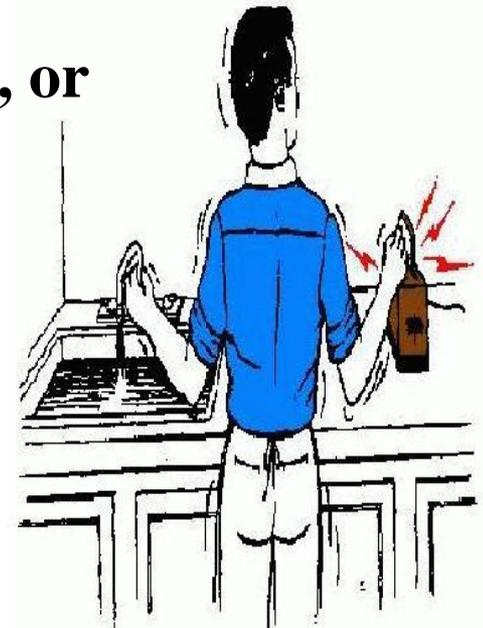
Ground Fault Circuit Interrupters (GFCI)



An unintentional electric path between a source of current and a grounded surface is referred to as a "ground-fault." Ground faults occur when current is leaking somewhere, in effect, electricity is escaping to the ground. How it leaks is very important. If your body provides a path to the ground for this leakage, you could be injured, burned, severely shocked, or electrocuted



**Hey, check it out!
lots of GFCI
information!!**



GFCI RECEPTACLES



**ALL GFCI
RECEPTACLES
HAVE A TEST
BUTTON**



TEMPORARY LIGHTING

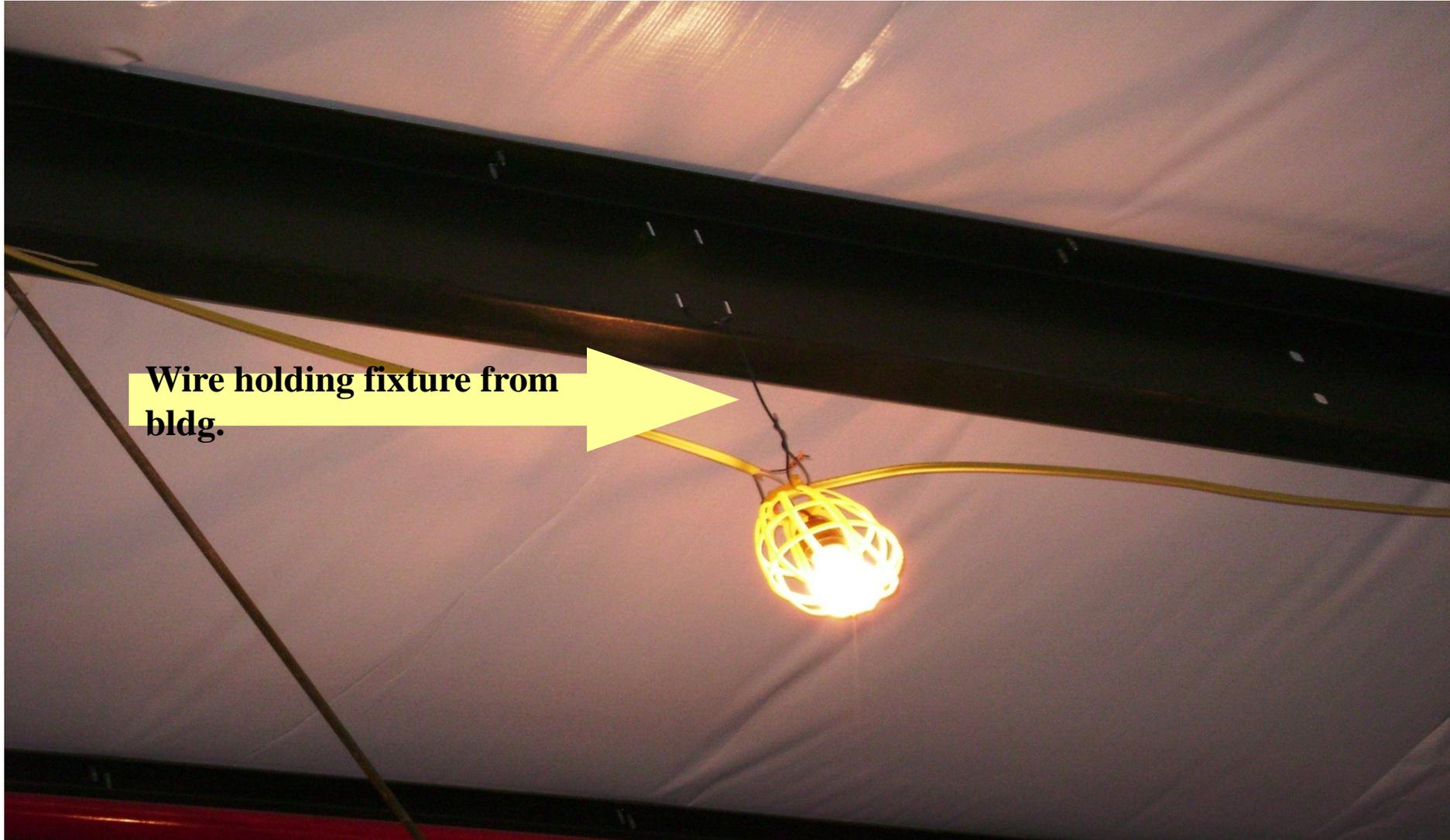


- All bulbs protected by guards.
- Not suspended by wires
- Empty sockets/broken replaced
- Confined spaces 12 volts or less.
- Temporary lighting circuits to be separated from receptacles.

Circuits labeled "**Lights only**"

Tool circuits "**Tools only**"

TEMPORARY LIGHTING



Wire holding fixture from
bldg.

TEMP. LIGHTING VIOLATION



ELECTRICAL SAFETY QUESTION



**AS YOU WALK
AROUND
THE JOB SITE YOU
NOTICE THE LIGHTS
GET DIMMER JUST
AS A WORKER
STARTS UP HIS
ELECTRIC SAW.
IS THIS A PROBLEM?
WHY?**



SAFE WORK PRACTICES



Vertical clearance for temporary wiring 600V less:

10 ft (3m) above finished grade, sidewalks, or from any platform.

12 ft (3.6m) over vehicular traffic other than truck traffic.

15 ft (4.5m) over areas for truck traffic.

18 ft (5.4m) over public streets, alleys, roads, and driveways

We need to raise these power lines and then re-submit our temporary power sketch too!



SAFE WORK PRACTICES



DANGER

**DO NOT OPERATE
WITHIN 10 FT. OF
POWER LINES**

SAFE WORK PRACTICES



WET LOCATIONS

A receptacle in a wet location to be contained in a weatherproof enclosure the integrity of which is not affected when an attachment plug is inserted.

**LOOK IN COE
11.D.04 THE NEXT
SLIDE HAS SOME
GREAT PHOTOS TOO!**



WET LOCATIONS



POWER CORD IN USE



COVER IN PLACE

SAFE WORK PRACTICES



Remove all conductive articles: jewelry and clothing, watchbands, bracelets, rings, key chains, necklaces, metal, cloth with conductive thread, or metal headgear.

Conductive?



TESTING OF A CIRCUIT



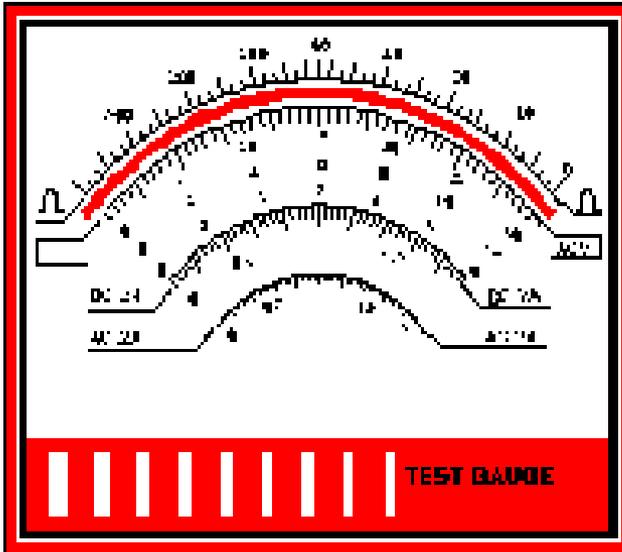
Verify system is de-energized.

Operate controls to verify equipment cannot be restarted.

Use test equipment to verify the circuits and electrical parts for voltage and current.



TESTING OF A CIRCUIT

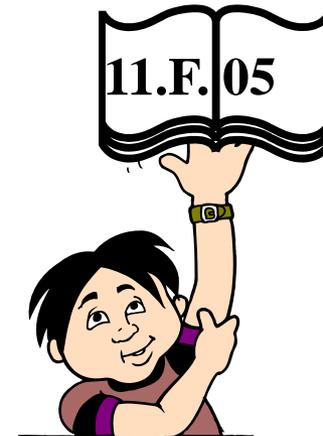
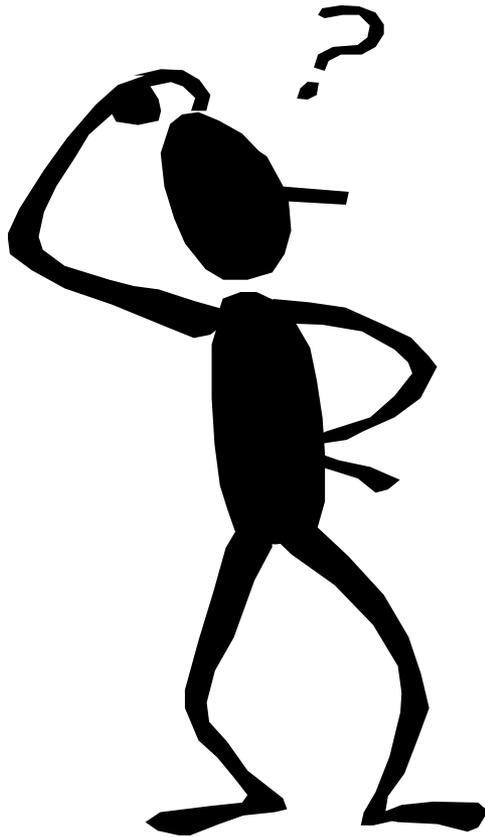


Test the test equipment, usually a voltmeter, on a known source of power of same rating, to insure the test equipment is working.

Test the test equipment always **before** you verify the circuit to be worked on, then test the equipment again **after!!**



**WHAT IS A MANDATORY
REQUIREMENT BEFORE
ANY WORK ACTIVITY
CAN BE DONE ON ANY
OVERHEAD POWER LINES?**



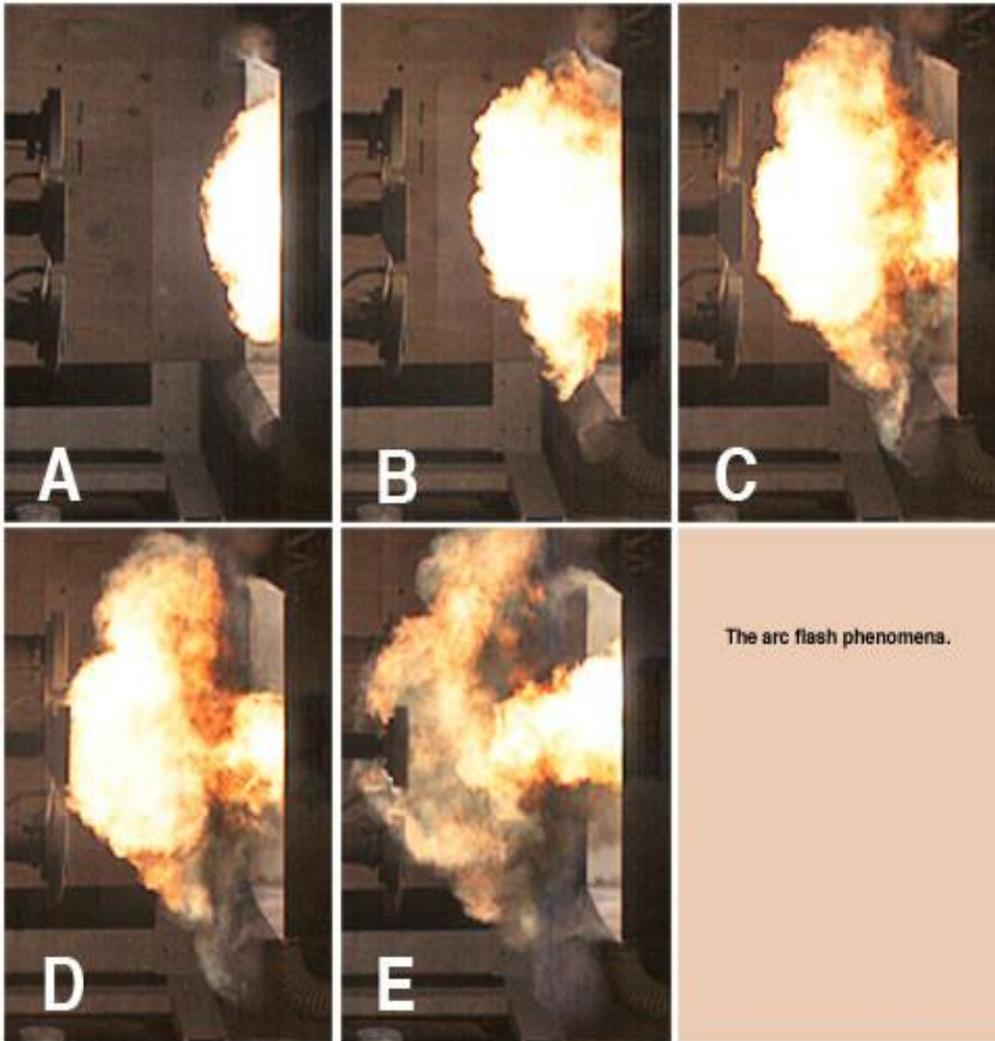
WHAT IS AN ARC FLASH?



A short circuit through the air when insulation or isolation between conductors is breached or can no longer withstand the applied voltage.

Workers on or near energized conductors or circuits, movement near or contact with the equipment or failure of the equipment may cause a fault resulting in Arc Flash

ARC FLASH SAFETY



The arc flash phenomena.

Temperatures 5000 F.

Explosions

Hot Gases

Melting Metal

Radiation Burns

Severe Eye Damage

Death

ARC FLASH SAFETY REQUIREMENTS



**WORK OVER 50 VOLTS ON
ENERGIZED PARTS:**

**ARC FLASH HAZARD ANALYSIS
IAW NFPA-70E TO DETERMINE
SAFE BOUNDARY FROM HAZARD**

**SYSTEMS 600 VOLTS AND LESS
MINIMUM BOUNDARY IS 4 FEET**

SPECIAL TRAINING

SPECIAL PPE FOR WORKERS

**50 Volts is
not very
high voltage**



ARC FLASH SAFETY



SPECIAL PPE

**ARC FLASH
COVERALLS
ARE BASED
ON ANTICIPATED
HAZARD**

**RATED IN
CALORIES
OF HEAT**



ARC FLASH SAFETY



TRAINING CERTIFICATE FOR WORKER

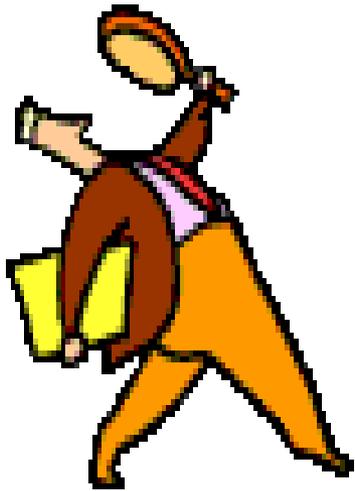
**Note: This ARC
flash suit is
rated at
11 Calories per
square centimeter**



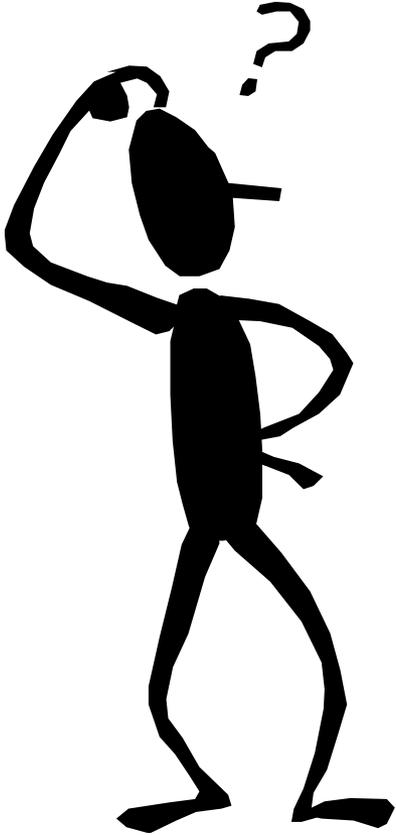
FLEXIBLE CORDS



**Size & number
of wires
Insulation
type printed
on the cord!**



FLEXIBLE CORDS



Where does a person find information about the letters that would indicate types of insulation for "Hard Usage and Extra Hard Usage" requirements?

FLEXIBLE CORDS

HARD SERVICE CORD & EXTRA HARD SERVICE

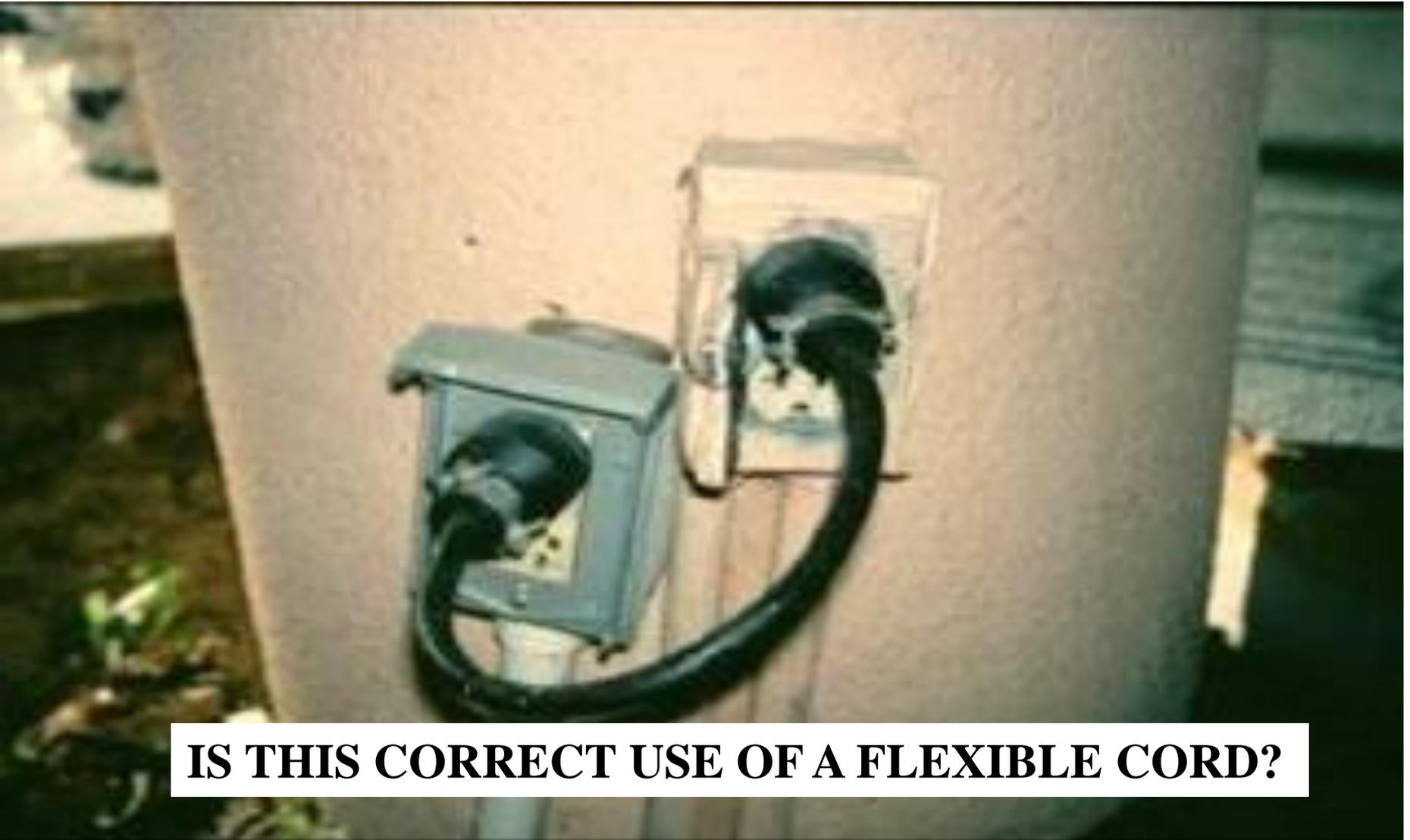
**S, SE, SEO, SO, SOO, ST
STO, STOO, SJ, SJE, SJEO
SJO, SJOO, SJT, SJTO
SJTOO**



A complete list
of all can be found
in NEC Art. 400



FLEXIBLE CORDS



IS THIS CORRECT USE OF A FLEXIBLE CORD?

FLEXIBLE CORDS



Inspected before use:

Loose parts, missing pins

Damage to insulation & outer jacket

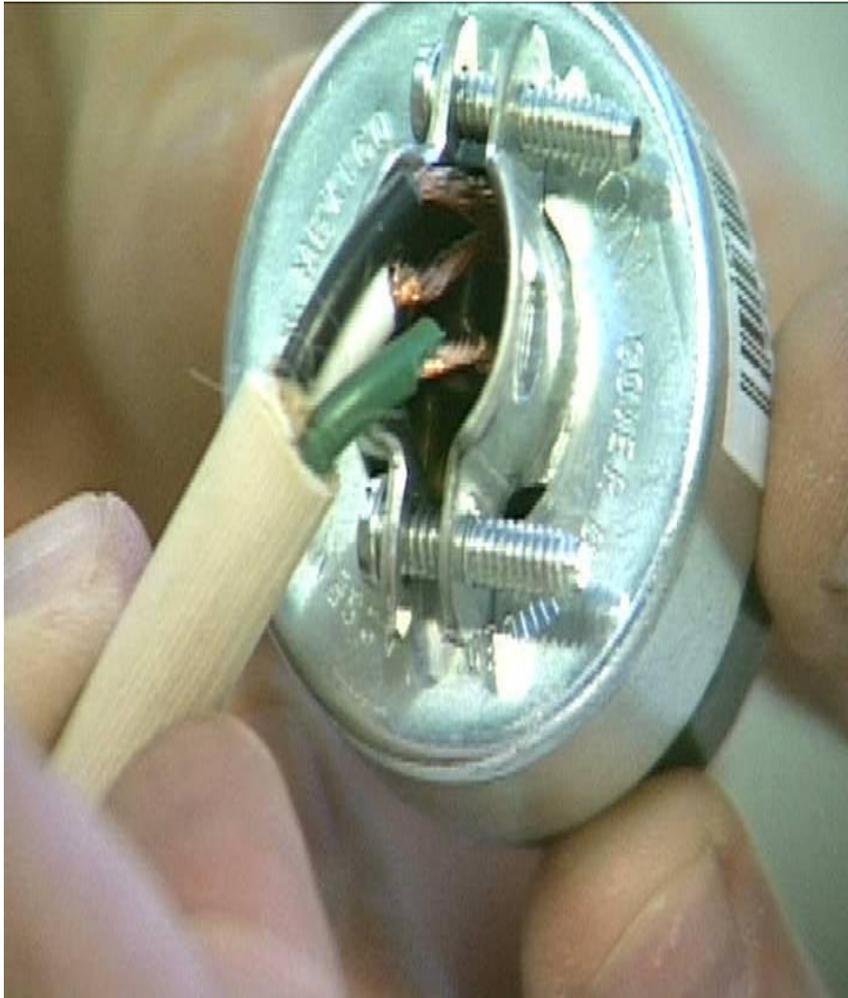
Properly protected at the jobsite

Protected by bushings or fittings if passing through holes

Look at the examples on the next few slides!!



FLEXIBLE CORD VIOLATIONS



FLEXIBLE CORD VIOLATIONS



HAND-HELD ELECTRIC TOOLS



Potential danger due to continuous contact with hands:

To protect from shocks, burns & electrocution tools required to have following:

3 wire cord, with ground plugged into GFCI receptacle or be double insulated or powered by low voltage transformer

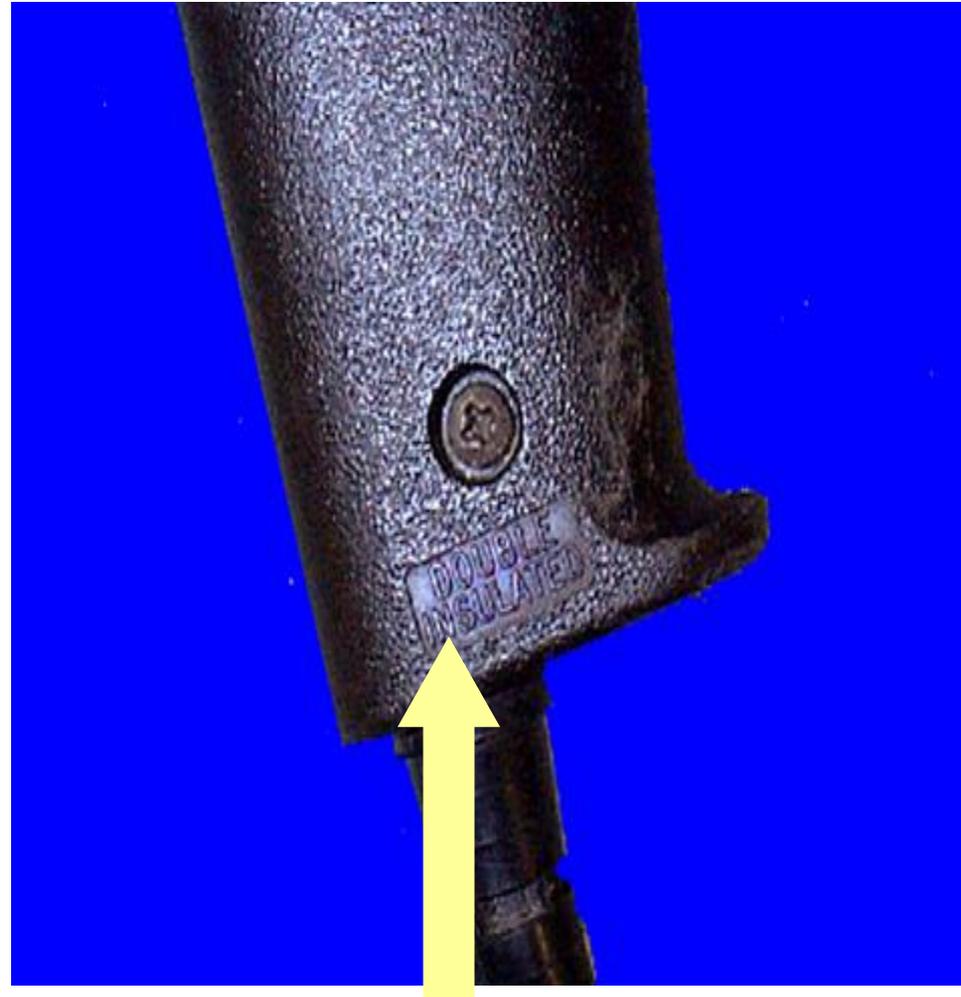
So what do I look for now?



HAND-HELD ELECTRIC TOOLS



**DOUBLE INSULATED
ELECTRIC DRILL**



DOUBLE INSULATED MARKING

ELECTRIC TOOL QUESTION



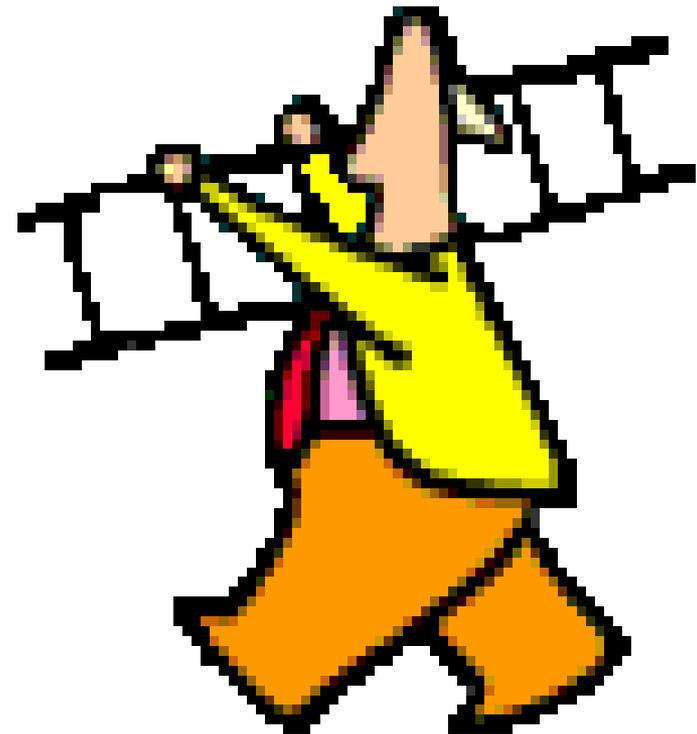
**A WORKER IS USING A
DOUBLE INSULATED
DRILL. SINCE IT IS
DOUBLE INSULATED
DOES HE HAVE TO
PLUG INTO A GFCI
PROTECTED CIRCUIT?**



ELECTRICAL WORK FROM LADDERS



**Non-conductive
side rails
At least 10 feet
away from all
electric lines**



PERSONAL PROTECTIVE EQUIPMENT

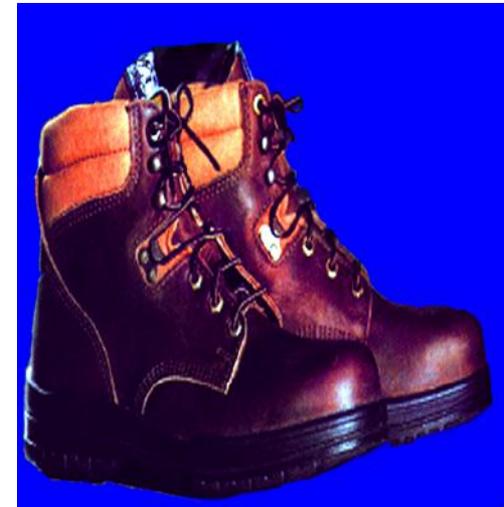


HARD HATS

Class "E" high voltage
work
Special High Voltage
gloves



EYE PROTECTION FOOT PROTECTION



PERSONAL PROTECTIVE EQUIPMENT



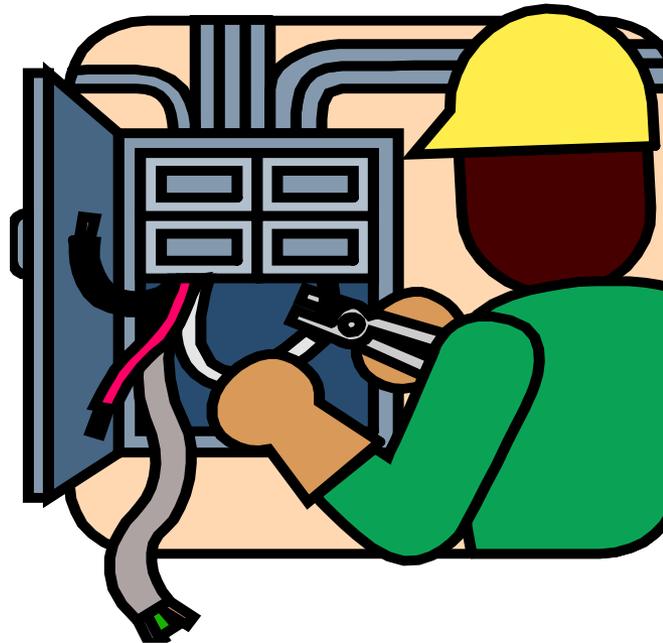
HIGH VOLTAGE GLOVES

A hole, tear, puncture, or cut ozone cutting or ozone checking the cutting action produced by ozone on rubber under mechanical stress into a series of interlacing cracks



Special PPE
& special
testing too!

Lock-out / Tag-out



Control of Hazardous Energy

Lock-out / Tag-out



Control of Hazardous Energy



- References

- EM 385-1-1 Section 12 Control of Hazardous Energy

- 29 CFR 1926.417 – Lockout and Tagging of Circuits

- 29 CFR 1910.147 – Control of Hazardous Energy

- UFGS 013526 – Governmental Safety Requirements

- ANSI Z244.1 – Personnel Protection - Lockout/Tagout of Energy Sources

- ANSI A10.44 - Control of Energy Sources

- Lockout/Tagout) for Construction and Demolitions Operations

Control of Hazardous Energy



- Direct causes of mishaps:
 - Lack of notification prior to re-energizing.
 - Not verifying de-energized state.
 - Failure to adequately bleed pressurized system before disassembly.
 - Unauthorized work
 - Lack of communication between workers.
 - Worker ignoring safety procedures.

Control of Hazardous Energy



- Indirect causes of mishaps:
 - Lack of Lock-out/tag-out program.
 - Workers not adequately trained or supervised.
 - Approved safety plan not implemented.
 - Regular site safety inspections not performed.
 - Lack of safety equipment and/or use.

Control of Hazardous Energy



- 12.A.03 – When contractor work involving hazardous energy will be performed on a Government Operated Facility, the following coordination must occur:
 - a – The GDA and the Contractor shall fully coordinate all control activities with on another throughout the planning and implementation of these activities.
 - b – When contractors are planning the use of Hazardous Energy Control procedures, they shall submit their Hazardous Energy Control Plan to the GDA for acceptance. Implementation of the Hazardous Energy Control Procedures shall not be initiated until the Hazardous Energy Control Plan has been accepted by the GDA.

Control of Hazardous Energy



- 12.A.04 – Systems with energy isolating devices that are capable of being locked out shall be locked out. If an energy isolating device is not capable of being locked out, the Hazardous Energy Control Procedures shall use tag out providing full personnel protection. See 12.A.11.c
- 12.A.05 – Locks must always be used when the clearance involves equipment that is accessible to the public.
- 12.A.07 – A preparatory meeting and inspection with the GDA and Contractor personnel shall be conducted to insure that all affected employees understand the energy hazards and the procedures for their control. This meeting/inspection shall be Documented.
- 12.A.08 – Lock-out and Tag-out shall be performed by only Authorized employees.
- 12.A.09 – All employees affected by Lock-out/Tag-out shall be notified, before and upon completion of the application and removal of locks and tags.

Hazardous Energy Control Program



- 12.A.12 – Hazardous Energy Control Program
- 12.A.12.a – HEC Procedures shall be developed in the Hazardous Energy Control Plan.
- 12.A.12.b – The Hazardous Energy Control Plan shall clearly and specifically outline the scope, purpose, authorization, responsibilities, rules and techniques to be used for the control of hazardous energy.
 - To include:

Control of Hazardous Energy

12.A.12.b cont...



- 1) Statement of intended use of the procedure;
- 2) Means of coordinating and communicating HEC activities;
- 3) Procedural steps for shutting down, isolating, blocking, and securing systems to control hazardous energy;
- 4) Procedural steps and responsibilities for the placement, removal, and transfer of lockout and tagout devices
- 5) Procedural steps, responsibilities and a means of accounting for placing and removing personal protective grounds,
- 6) Procedural steps, responsibilities and requirements for testing the system to verify effectiveness of isolation, lockout/tagout devices;
- 7) Procedural steps and responsibilities for transfer of clearances when and if necessary;
- 8) Procedures steps and responsibilities for Multi- Shift Safe Clearances;
- 9) A description of any emergencies that may occur and procedures for safely responding to those emergencies;
- 10) The means to enforce compliance with the procedures.

Lock-Out/Tag-Out

- Breaker LO/TO



- Switch Box LO/TO



Lock-Out/Tag-Out

UFGS 013526



3.2 PRE-OUTAGE COORDINATION MEETING

- **Contractors are required to apply for utility at least 15 days in advance.**
- **Once approved and prior beginning, work contractor must attend a pre-outage coordination meeting with the Contracting Office [and the] [installation representative] [Public Utilities representative] to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.**

3.3 SAFETY LOCKOUT/TAGOUT PROCEDURES

Contracting Officer will, at the Contractor's request, apply lockout/tagout tags and take other actions that, because of experience and knowledge, are known to be necessary to make particular equipment safe to work on.

Lock-Out/Tag-Out UFGS 013526



3.3.1 TAG PLACEMENT (3rd paragraph)

When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as “Providing Safety Clearance”

3.3.2 TAG REMOVAL

When any individual or group has completed its part of the work and is clear of the circuits or equipment , the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the Contracting Officer. That group's or individual lockout/tagout tags on equipment may be removed on authorization by the Contracting Officer.

Control of Hazardous Energy



- 12.B – Training
- 12.B.01 – Training shall be provided to ensure that the purpose and function of the Hazardous Energy Control procedures are understood by employees and that employees possess the knowledge and skills required for the safe application, usage and removal of Hazardous Energy Control Devices.
 - a Authorized Employee Training
 - b. Each affected employee.....
 - c. All incidental personnel shall be informed.....
 - d. When only tagout systems are employees shall be trained in the limitations of tags.

- 12.B 02 Employee retraining requirements..
- 12.B.03 The supervisor shall certify and document all training and retraining.

Periodic Inspections

12.C

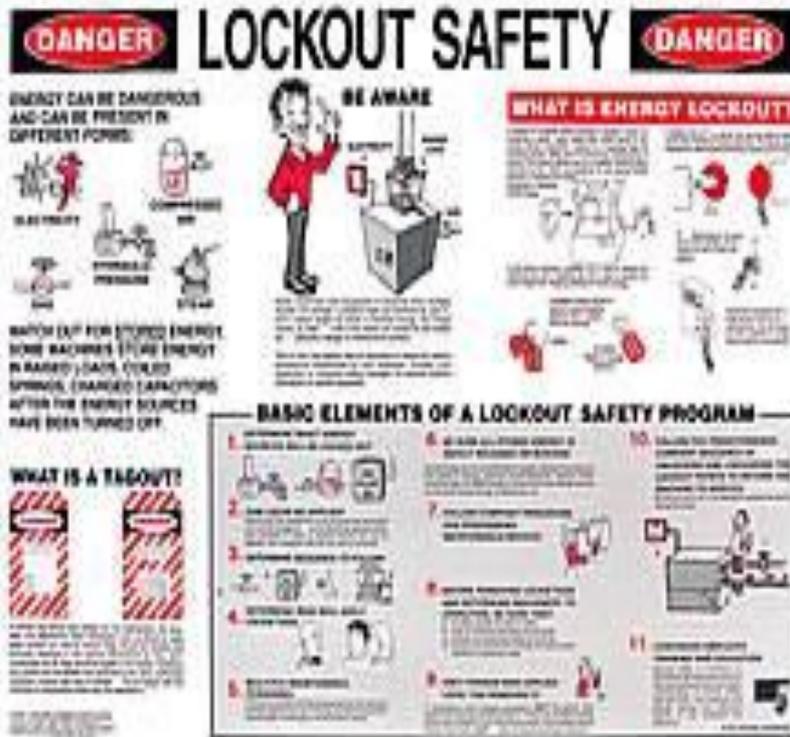


- 12.C.01 – Daily inspections shall be conducted to ensure that all requirements of the Hazardous Energy Control procedures are being followed.
- 12.C.02 – Periodic Inspections shall be documented and shall specify the system where the Hazardous Energy Control procedures were inspected, the date of the inspection, the names of employees performing and included in the inspections and any deficiencies in complying with the Hazardous Energy Control procedures.

Lock It and Tag It Before Servicing

- Lock Out Safety

- Lock Out and Tag Out



WORK AREA SAFETY



NO work on energized electrical parts without adequate illumination.

If there is an obstruction that prevents seeing your work area or if you must reach blindly into areas which may contain energized parts.

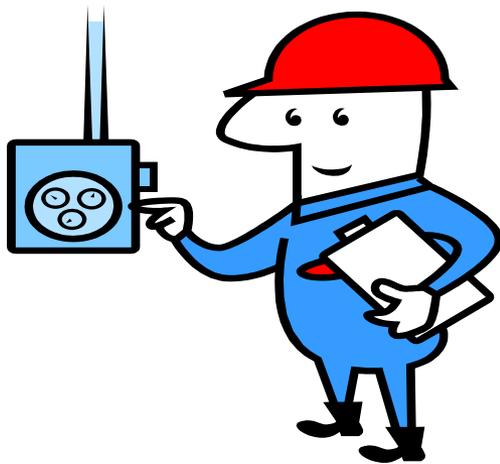


CIRCUIT IDENTIFICATION



DISCONNECTS FOR MOTORS & APPLIANCES
Legibly marked to identify

SERVICE, FEEDER & BRANCH CIRCUITS &
Disconnecting means or over-current device to be legibly marked to indicate its purpose.

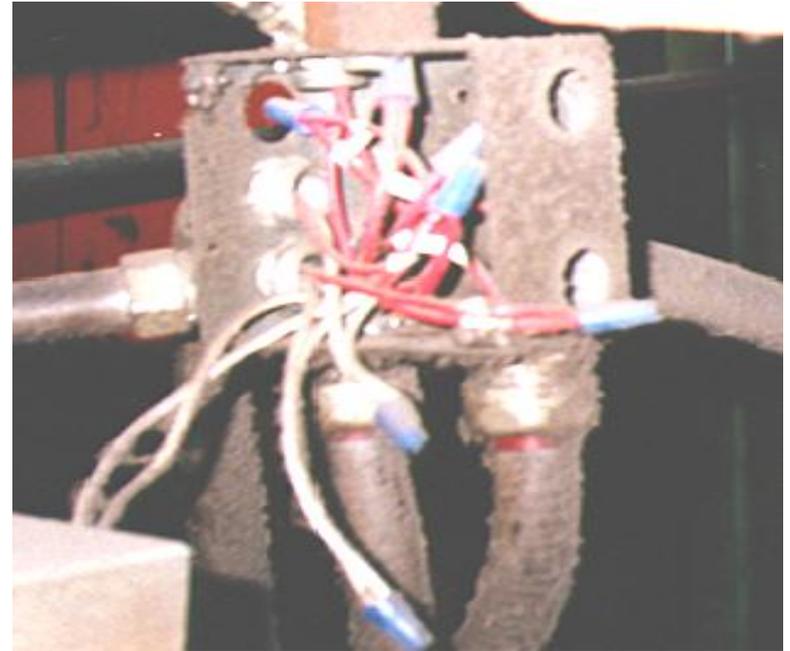


CABINETS, BOXES, AND FITTINGS

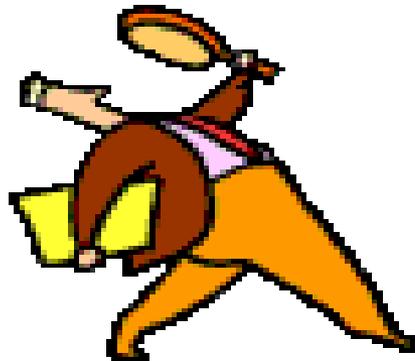


Pull and junction boxes and fittings must have approved covers

Unused openings must be closed (no missing knockouts)



That is easy to spot!!!



HIGH VOLTAGE SAFETY



**WHAT IS THE
CLOSEST DISTANCE
THAT A MOBILE
CRANE CAN BE SET-UP
NEXT TO HIGH
VOLTAGE POWER
LINES?**



ELECTRICAL PROBLEMS



This photo a violation of OSHA, EM-385 and/or NEC

ELECTRICAL PROBLEMS



This photo a violation of OSHA, EM-385 and/or NEC

ELECTRICAL PROBLEMS



This photo a violation of OSHA, EM-385 and/or NEC

ELECTRICAL PROBLEMS



This photo a violation of OSHA, EM-385 and/or NEC

ELECTRICAL PROBLEMS



This receptacle was mounted inside a soap bottle. It was used by a homeowner as an extension cord while floating around in a pool so he could save batteries while watching a portable television.



Photo taken of an example of a "stupid persons" ingenuity