AVOID GETTING ELECTROCUTED

By Lew Silecky, C.E.T., Manager, Technical Sales & Marketing, Ferraz Shawmut

Recently, there has been a lot of focus on arc flash and the hazards associated with it, however, arc flash incidents are not the only thing that can cause death and severe injury.

Electricity can be our friend and, more so, it can be our greatest enemy. Electricity cannot be seen, tasted, heard or smelled. Because of this phenomenon, it is extremely dangerous to those who do not take the proper precautions and those who are not educated.

As can be seen in Table 1., it does not take a lot of current to kill. Yes, current. Many people think it is voltage that kills. This is not exactly true. Voltage causes the burn, because it is the driving potential behind the current and contains the energy.

According to OSHA Statistics, there are several hundred deaths annually that are attributed to electric shock.

Where do these incidents occur? Surprisingly, in the home, commercial industrial, businesses, farms and utilities, where people come in contact with 120Volts. These statistics can further be broken down into over 4,000 non-disabling and just about as many disabling injuries and death. A staggering statistic, and one that must be eliminated.

How do we avoid the risk? The answer – through education and using a lot of common sense!

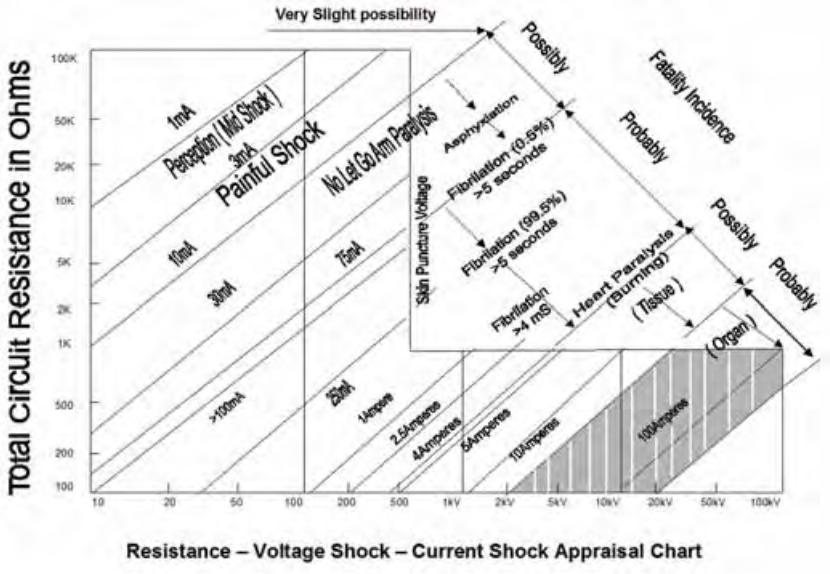
Let us first consider the human body. We are really nothing but a big sack of electrolyte with little resistance. The average human has a worst case resistance of only 1000 ohms, measured hand to hand. If we apply Ohm's law using 120Volts, then it can be seen that if contact occurs, then 120mA of current can flow through the body. This can be further explained by Figure 2. For example, if we look at the vertical line at 110 volts and consider the average body resistance varies from 1kΩ to about 100MΩ, then we can see that the onset of perception to painful cessation appears at between 1 and 10mA. Since it is difficult to get a precise resistance value for skin, if the lower value is used, then we can see that "No Go" Arm paralysis may occur. The potential required for skin puncture is 500V.

AC OR DC?

Does it make a difference? See figure 3., and how it could affect you. Since only between 25-60mA of current is required to put you into respiratory paralysis at 120V AC it only takes about the same amount at 80V DC. The people at risk here are those who work around battery systems, UPS, Inverters, as well as other DC sources.

Current	Effect
1 mA	Barely Perceptable
1 - 3 mA	Preception Threshold (Most Cases)
3 - 9 mA	Painful Sensation
9 - 25 mA	Muscular Contractions (Can't let go)
25 - 60 mA	Resperatory Paralysis (May be fatal)
60 mA or More	Ventricular fibrillation (Probably fatal)
4 A or More	Heart Paralysis (Probably fatal)
5 A or More	Tissue Burning (Fatal if a Vital Organ)

Table 1: Shock Hazard



Resistance – Voltage Shock – Current Shock Appraisal Chart

Figure 2: Resistance – Voltage Shock – Current Shock Appraisal Chart

AC (60 HZ) mA	DC (mA)	Effect
0.5 - 1.5	0 - 4	Perception
1 - 3	4 - 15	Surprise (Reaction)
3 - 22	15 - 88/	Reflex Action (Let Go)
21 - 40	80 - 160	Muscular Inhibition
40 - 100	160 - 300	Respiratory Block
> 100	> 300	Usually Fatal

Figure 3: AC Vs. DC Shock Hazard Effect

RECOMMENDATION

Accidents are best prevented by the proper use of insulated tools, guarding and labeling of equipment, grounding, electrical protective devices and above all, safe work practices. It is extremely important that persons working in areas where they can be exposed to electric shock hazard are very cognizant of the fact of the physiological effects of current flowing through the body. The NFPA70E-2004 "Shock Hazard Analysis" will provide guidance required to take the necessary precautions and determinations for protection boundaries as well as approach limits for both qualified and unqualified personnel.

As Figure 4 illustrates, electrical burns caused from contact, where the water under the skin has vaporized.

Use common sense! When working in a potentially hazardous location do some homework.

• Locate and identify power lines.

• Insulate the lines, can you have them removed? Don't know? Contact your local utility.

• Use a signal man when operating equipment such as backhoes, cranes, or other boom devices.

• Make sure the operator and the signaller work as a team and understand signals.

• Avoid the use of aluminum or metal reinforced ladders

• Don't work under damp conditions, even a wooden ladder can be fatal.

• Be cautious of moving long items, such as pipes and siding when working under hydro lines.

• Be aware of wind and swaying hydro lines.

Overhead Contact Guidelines

Voltage Rating	Minimum Distance
750 – 15kV	3 metres – 8 feet
15.1kV – 25kV	4.5 metres – 12 feet
Over 25kV	6 metres – 15 feet

SOME DOS AND DON'TS

Some points to consider when safeguarding against electrocution.

• Don't cut or bend back the ground pin.

• Don't use a cheater or adapter. These are illegal.

• Check your extension cords for continuity, polarity and insulation wear.

• Check your duplex outlet for polarity and ground fault.

• Are your hand tools double insulated? Are the housings cracked?

• Don't hold onto any metal pipes while drilling.

• Do use GFCIs on all tools. It's the law.

WHAT ELSE CAN I DO TO PROTECT MYSELF AND MY WORKERS?

NFPA70E-2004 has already been mentioned, but what does it mean? Article 90 introduces us to Electrical Safety in the workplace and defines in specific terms what is covered by the standard. Article 110 is perhaps one of the more important parts of NFPA70E-2004, because it defines the Electrical Safety related practices that must be followed to ensure safety for you and your workers. In this part of the standard, responsibilities are outlined. Training, Job Briefing, Relationships, Working on or near circuit parts, and Use of Equipment are all discussed and need to applied to your safety program as a

Figure 4: Electrical Burn

defense mechanism against the hazards of electricity and working on or near live parts. In fact, Section 130 of the NFPA70E requires justification for working on live equipment, and Section 120 talks about the proper procedures that should be taken for lockout/tagout of equipment.

So, how do we put all of this into perspective? By following these six steps you can ensure that your equipment is placed in an electrically safe condition.

• Check your drawings and all applicable sources of electrical supply.

• Interrupt the load current properly and open the disconnecting devices for each source.

• Ensure that the blades of the disconnecting device are visible, if possible, to ensure they are open. In the case of a breaker, ensure it is fully withdrawn or disconnected.

• Apply the lockout/tagout devices in accordance with your policy and documentation.

• Ensure that when verifying for presence of voltage, the proper rated voltage detector is used. Make sure that voltage is checked between all phases and also to ground. Make sure your voltage detector is in proper working order and set to the correct scale and that you verify on a known source before measuring on the actual source. Set, verify, measure and verify again. Use a meter with fused leads.

• Ensure proper grounding for conductors which may have induced or stored electrical charges or energies. Make sure that grounding devices are suitable rated for the available fault levels.

Other ways of protecting you and your workers is by using IP20 Finger Safe Products. If you can't touch it, you can't be electrocuted! What does IP20 mean? IP stands for Ingress Protection for people and equipment, the "2" indicates protection against touching live parts.

PREVENTION – FINGER SAFE PRODUCTS

Realizing that you cannot always work on de-energized systems, the next best way to offer protection against accidental shock is by using "finger safe" devices. UTRASAFE™ fuse holders for Midget, Class CC and Class J fuses are one way to provide protection. For terminal protection use the FSPDB – Finger Safe Power Distribution Block.

These holders and terminal blocks offer an IP20 grade of protection, which means that the holder/block will not allow an object greater than 12mm or 1/2" depth to penetrate between surfaces, thereby making it "finger safe".

You might think, why IP20? Why should I buy a finger safe device? A good reason would be OSHA's increased scrutiny on safety and the requirements of the NFPA 70E. It's critical to provide safer panels. This eliminates the need for more costly methods such as mounting plexiglass sheets to cover the entire panel.

FSPDB, Finger safe Power Distribution Blocks

So, don't be a statistic of toxic energy. Remember, you can't see it, smell it, hear it or taste it, and you don't have to work in the electrical industry to get shocked.