ELECTRICAL Safety Measures

"Elimination is the first priority! Ensure a risk assessment is completed before energized work tasks are completed."

Portable Cord-and-Plug-Connected Electrical Equipment & Extension Cords

By Terry Becker, P.Eng., CESCP, IEEE Senior Member

It is critically important that all industrial, commercial, institutional and construction industry employers ensure they place appropriate focus on the electric shock hazard. Over the last eleven years since the CSA Z462 Workplace electrical safety Standard published awareness has increased with both the arc flash and shock hazard, but industry unfortunately has placed too much emphasis on arc flash where a small percentage of workers (e.g. Qualified Electrical Worker, Task Qualified Workers, Qualified Instrumentation Workers) are exposed.

All workers, and specifically non-electrical workers, are frequently exposed to the electrical shock hazard with the use of portable cord-and-plug-connected electrical equipment and extension cords, when in proximity to energized overhead power lines and while exposing buried energized cables.

We have predominately placed a lot of focus on high voltage (>750V) electrical equipment, but we need to ensure that workers using low voltage (31 to 750V) portable cord-and-plug-connected electrical equipment and extension cords use them properly. The voltage in our homes and used in the workplace that we may take for granted is 120VAC single phase. Electrical equipment that is 120VAC is a shock hazard that can electrocute a worker.

Table 1 – Effects of Electrical Current Flow Through The Human Body

Current mA (milli-amps)	Physiological Effect On Human Body	Human Perception & Effect On Human Body
< 1ma	None	Imperceptible
1 mA	Perception threshold	Mild sensation
1-10 mA		Painful sensation
10 mA	Paralysis threshold of arms and hands	Cannot release hand grip "no let go" threshold
30 mA	Respiratory paralysis	Breathing may stop
75 mA	Heart fibrillation possible	Heart action miscoordinated
250 mA	Heart fibrillation	Heart may stop
4 amps	Heart paralysis threshold	Heart stop for duration of current flow
5 amps or greater	Tissue burns	Most likely fatal vital organs are burned or damaged, can lead to amputation of limbs

Note: Amount of current, current flow path through the human body, and length of time of current flow through the human body determines heart fibrillation probability. Male and female body resistance will be different. Wet or dry skin at point of current entry will impact current flow.

Portable Cord-and-Plug-Connected Electrical Equipment & Extension Cords

The following list of electrical safe work practices is recommended:

1. Ensure the portable cord-and-plug-connected electrical equipment and extension cord are CSA approved for their usage.

2. Portable cord-and-plug-connected electrical equipment and extension cords shall be visually inspected before use for external defects such as loose parts, deformed and missing pins, damage to outer jacket or insulation, and for possible internal damage such as pinched or crushed outer jacket. Any defective cord or portable cord-and-plug-connected electrical equipment must be removed from service, tagged, and given to a Supervisor and no person may use it until it is repaired and tested to ensure it is safe for use.

3. **ELECTRICIAN'S TAPE IS NOT AN APPROVED METHOD OF REPAIR!** Any portable cord-and-plug-connected electrical equipment or extension cord found with electrician's tape used shall be taken out of service!

4. Extension cords must be of the three-wire type. Extension cords and flexible cords must be designed for hard or extra hard usage (for example, types S, ST, and SO). The rating or approval must be visible.

5. Portable electrical equipment must be handled in a manner that will not cause damage. Flexible electric cords connected to electrical equipment may not be used for raising or lowering the electrical equipment.

6. Extension cords shall be protected from damage. Sharp corners must be avoided. Extension cords shall not be run through windows or doors unless protected from damage, and then only on a temporary basis.

7. Extension cords shall not be run above ceilings, inside or through walls, ceilings or floors, through doors, and may not be fastened with staples or otherwise hung in such a fashion as to damage the outer jacket or insulation.

8. Extension cords must be covered by a suitable cord protector and/or taped down when they extend into a walkway or other path of travel to avoid creating a trip hazard.

9. Attachment plugs and receptacles may not be connected or altered in any way that would interrupt the continuity of the equipment grounding conductor. Clipping the grounding prong from an electrical plug is prohibited.

10. Extension cords may only be plugged into grounded receptacles. Adapters that interrupt the continuity of the equipment grounding connection may not be used.

11. All portable electric equipment and extension cords used in highly conductive work locations, such as those with water or other conductive liquids, or in places where employees are likely to contact water or conductive liquids, shall be approved for those locations.

12. Employee's hands must be dry when plugging and unplugging extension cords and cord-and-plug-connected electrical equipment if energized equipment is involved.

13. If the connection could provide a conducting path to the worker's hands (for example, if a cord connector is wet

from being immersed in water), the energized plug and receptacle connections must be handled only with insulating protective equipment.

14. Locking-type connectors must be properly locked into the connector.

15. Incandescent lamps for general illumination must be protected from breakage, and metal shell sockets must be grounded.

16. Temporary lights must not be suspended by their cords unless they have been designed for this purpose.

17. Extension cords are considered to be temporary wiring.

Ground Fault Circuit Interrupters (GFCIs)

It is also important that in our homes and at our workplaces that we ensure we use a Ground Fault Circuit Interrupter (GFCI) when required and that we follow appropriate safe work practices.

1. Personnel performing work tasks using extension cords where work is performed in damp or wet indoor or outdoor locations shall be provided with and must use a GFCI (e.g. integrated into receptacle or of the portable in line type, Class A must trip at 4-6mA).

2. GFCIs are reliable devices that limit fault current and prevent electrocutions. The range of current permitted in a GFCI protected circuit is much below that necessary for an electrocution to occur (e.g. 4-6 mA for Class A). GFCIs shall be required for all temporary installations and in wet conditions.

3. In the workplace the use of portable GFCI protection is the most practical solution to assure that a GFCI is used.

4. All GFCIs shall be inspected and tested before each use (e.g. hit the TEST and RESET buttons and ensure the GFCI functions properly).

It is important that we continue in industry across Canada to ensure shock and arc flash hazards are appropriately identified, risk assessments completed and additional protective measures implemented to reduce risk if we cannot eliminate exposure. Arc flash has overwhelmed industry and there is significant misinformation and myths related to its identification. The electric shock hazard has been neglected. Available electrical incident statistics prove that the electric shock hazard exposure to all workers is occurring at a very high frequency, and electrocutions occurring at least once a day in North America and higher annual frequencies globally depending on the country. Besides managing proximity to overhead power lines and exposure to energized buried cables more effectively, employers need to ensure they place more emphasis for all non-electrical workers on the shock hazard exposure risk when using portable cord-and-plug-connected electrical equipment and extension cords.

The CSA Z462 Workplace electrical safety Standard and its controlled application through a documented, implemented and audited Electrical Safety Program that includes electrical safety awareness training and ongoing communication for non-electrical workers (e.g. something as simple as posters on safety bulletin boards) is required.

***Terry Becker**, P.Eng, CESCP, IEEE Senior Member is the first past Vice-Chair of the CSA Z462 Workplace electrical safety Standard Technical Committee and currently a Voting Member and Working Group Leader for Clause 4.1 and the Annexes. Terry is also a Voting Member on the CSA Z463 Maintenance of electrical systems Standard and a Voting Member of the IEEE 1584 Guide for Performing Arc-Flash Hazard Calculations. Terry has presented at Conferences and Workshops on electrical safety in Canada, the USA, India and Australia. Terry is a Professional Engineer in the Provinces of BC, AB, SK, MN and ON. Terry is an Electrical Safety Specialist, Management Consultant, and can be reached at 587.433.3777 or by email **terry.becker@twbesc.ca**.*