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Electrical Safety Guidelines

FOR THE UNIVERSITY COMMUNITY

Bureau de la gestion du risque, de l'environnement et de la santé-sécurité au travail

Office of Risk Management, Environmental Health and Safety

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[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

1. INTRODUCTION

The University of Ottawa is committed to providing a healthy and safe work and educational environment for all of its employees, students and visitors. The intent of this document is to provide general information on electrical safety and an overview of the legislation applicable in Ontario. It does not replace any relevant laws, regulations or codes for which the University must comply. When applicable, consult the Occupational Health and Safety Act, the Industrial Establishments Regulation, the Construction Projects Regulations, the Ontario Electrical Safety Code for detailed information and specific requirements and restrictions.

2. OBJECTIVE

These guidelines provide information to the university community to safely use common electrical equipment, supplies or devices. The document also describes elements to consider prior to using new equipment or used equipment newly acquired in order to ensure your safety and that it meets current regulation, code or standard.

3. SCOPE

Anyone within the University of Ottawa workplace such as staff, students, volunteers as well as visitors who may be exposed to potential electrical hazards.

4. TRAINING AND EDUCATION TO CONDUCT ELECTRICAL WORK

According to the Ontario Occupational Health and Safety Act and its Regulations:

No worker other than an electrician certified under the Trades Qualification and Apprenticeship Act to do electrical work or a person with equivalent qualifications by training and experience shall connect, maintain or modify electrical equipment or installations. (0.Reg.213/91, sec181)

A worker without the qualification described in the previous section may insert an attachment plug cap on the cord of electrical equipment or tool into, or remove it from, a convenience receptacle. (OReg. 213/91, sec181(3)

5. RESPONSIBILITIES

According to Policy 77 of the University of Ottawa

Principal investigators/supervisors and all others in authority must:

- Incorporate preventive measures in all functions and activities in which there may be some incident or accident with health-related consequences;
- Provide information, instruction, and supervision to employees to protect their health or their safety;
- Provide safety training opportunities for all their personnel;
- Ensure that employees under their authority use or wear the equipment, protective devices or clothing required;
- Provide equipment, materials and protective devices, and ensure they are maintained in good condition and used as prescribed under the OH&S Act;

Workers must:

- Work in compliance with the provisions of the *OH&S Act* and all health and safety procedures and instructions;
- Use or wear the equipment, protective devices or clothing that the University requires to be used or worn and report to their supervisors the absence of or defect in any equipment or protective device of which they are aware and which may endanger themselves or other employees;
- report to the appropriate supervisory staff all known health and safety hazards or any violation of the *OH&S Act* or its regulations;

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

- not use or operate any equipment, machine, device or thing or work in a manner that endangers themselves or other employees and not remove or make ineffective any protective device required by the regulation or by the University, without providing an adequate temporary protective device; when the need for removing the protective device has ceased, the original protective device shall be reinstalled immediately;

Disciplinary Measures
Employees who contravene this policy are subject to disciplinary measures in accordance with the policies (Policy 2d Disciplinary Measures for Reprehensible Acts) and collective agreements governing their work conditions.

When non staff personnel violate this policy, the person in charge of the activity taking place must take the necessary measures to have the policy followed.

6. LEGISLATION

Below are the main requirements related to the use, handling or repair of electrical equipment, according to the *Industrial Establishments Regulation (Reg. 851), under the Occupational Health and Safety Act*:

- *Electrical equipment, insulating materials and conductors shall be,*
  a) Suitable for its use; and
  b) Certified by,
    i. The Canadian Standards Associations, or
    ii. The Electrical Safety Authority, as defined in the Electricity Act.
    (Reg. 851, s.40).

- *Tools and other equipment that are capable of conducting electricity and endangering the safety of any worker shall not be used in such proximity to any live electrical installation or equipment that they might make electrical contact with the live conductor. (Reg. 851, s.43).*

- *Cord-connected electrical equipment and tools shall have a casing that is adequately grounded. (Reg. 851, s.44 (1)).*

  -It does not apply to cord-connected electrical equipment or tools that are adequately double-insulated and whose insulated casing shows no evidence of cracks or defects. (Reg. 851, s.44 (2)).

  -It does not apply to a portable electrical generator in which the equipment is not exposed to an external electric power source if the casings of portable electrical tools connected to the generator are bonded to a non-current-carrying part of the generator.(Reg. 851, s.44(3)).

- *When used outdoors or in wet locations, portable electric tools shall be protected by a ground fault circuit interrupter installed at the receptacle or on the circuit at the panel. (Reg. 851, s. 44.1)*

- *A ground fault that may pose a hazard shall be investigated and removed without delay. (Reg 851, s. 44.2)*

- *The entrance to a room or similar enclosure containing exposed live electrical parts shall have a conspicuous sign, warning of the danger, and forbidding entry by unauthorized persons. (Reg. 851, s. 41)*

- *The power supply to electrical installations, equipment or conductors shall be disconnected, locked out of service and tagged before any work is done, and while it is being done, on or near live exposed parts of the installation, equipment or conductors. (Reg. 851, s. 42 (1))* . Physical Resources Service developed in collaboration with the Office of Risk Management, Environmental Health and Safety (ORMEHS), a lockout procedure for their use (http://www.uottawa.ca/services/immeub/lockout.htm). If you need to develop one for your unit, we invite you to consult the ORMEHS.

- Provisions are provided when lockout is not required. For further information on this, consult Section 42 of the Industrial Establishments Regulation.

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

7. ELECTRICAL EQUIPMENT APPROVAL

By law, no piece of electrical equipment in Ontario may be sold, displayed or even connected to a source of power unless it is approved (Ontario Electrical Safety Code Rule 2-022).

To ensure the safety of everyone on campus, and to meet current Ontario legislation, all electrical equipment must be suitable for its use and certified by:

(i) The Canadian Standards Association (CSA), or
(ii) The Electrical Safety Authority (ESA).

The Ontario Electrical Safety Code recognizes certification organizations accredited by the Standards Council of Canada to approve electrical equipment. Only equipment bearing one of the marks or labels shown in the drawings of Section 8 is approved.

The Electrical Safety Authority (ESA) warns the Ontario public that unapproved electrical products present a high-risk of potential electrical shock and fire hazard. When obtaining electrical products, verify the existence of a certification mark from a recognized certification agency.

Note: The Electrical Safety Authority was created in April 1999 to assume Ontario Hydro's responsibilities for electrical inspections in this province. Ontario Hydro's Electrical Inspection therefore became the Electrical Safety Authority (ESA).

8. CERTIFICATION AND FIELD EVALUATION MARKS ACCEPTABLE IN ONTARIO

8.1 CERTIFICATION AGENCY[1]

The following are recognized electrical certification marks acceptable under the Ontario Electrical Safety Code:

Canadian Standards Association (CSA)

Entela

Intertek Testing Services

[1] Source of Information is from the Electrical Safety Authority Website, Bulletin 2-7-14

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

Met Laboratories Inc. (MET)

OMNI Environmental Services Inc.

Quality Auditing Institute

TUV America

TUV Rheinland

Underwriters Laboratories of Canada

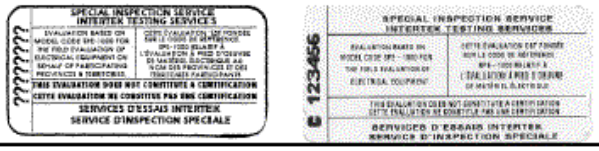
8.2 FIELD EVALUATION MARKS

The following are the acceptable field evaluation marks under the Electrical Safety Code[1]
Electrical products can only be approved by agencies that have been accredited by the Standards Council of Canada to approve electrical equipment. No other product approval markings are accepted in Ontario. (See Section 14 for further information)

[1] Source of Information is from the Electrical Safety Authority Website

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

FIELD EVALUATION MARKS ACCEPTABLE UNDER THE ELECTRICAL SAFETY CODE

CANADIAN STANDARDS ASSOCIATION (CSA)	
ELECTRICAL SAFETY AUTHORITY (ESA)	
ENTELA	
INTERTEK TESTING SERVICES	
ONTARIO HYDRO (OH)	
QUALITY AUDITING INSTITUTE (QAI)	
TUV RHEINLAND (TUV)	
UNDERWRITERS LABORATORIES OF CANADA (ULC)	

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

Component Marks Acceptable under the Electrical Safety Code which are specifically used on component parts that are part of a larger product or system

Canadian Standard Association (CSA)	
Underwriters Laboratories Inc. (UL)	 

Note: Electrical components bearing these marks may have restrictions on their performance or may be incomplete in construction, and are intended to be used as part of a larger approved product or system. The Component Recognition marking is found on a wide range of products, including some switches, power supplies, printed wiring boards, some kinds of industrial control equipment and thousands of other products.

9. TIPS TO KEEP YOU SAFE FROM ELECTRICAL HAZARDS

9.1 GENERAL PRECAUTIONARY MEASURES

The following will provide you with general information on electrical safety:

- Verify that all electrical equipment is “approved” with recognized approval markings to ensure they meet the electrical safety requirements for Ontario.
- Electrical equipment that is plugged into a power source should NEVER be handled if your hands or feet are wet.
- Do not allow cables and plugs to get wet. Thus, keep liquids away from electrical equipment.
- Electrical equipment used in wet locations must be protected with a GFCI (Ground-Fault Circuit Interrupter).
- Unplug equipment by pulling on the plug not the cord.
- Damaged electrical equipment that constitute an electrical hazard are not to be used until properly repaired/or replaced.
- Never connect electrical cords in series.
- Multiple outlets and power bars should have an automatic circuit breaker, surge protector and on/off switch.
- All electrical circuit disconnects or panels must not be blocked.
- Know the manufacturer’s recommended limits on the use of the electrical product and follow those recommendations precisely. These limits may be found on written instructions that accompany the electrical product.
- Ground pins on the plugs and the devices plugged into the receptacles must be intact.
- Do not use any personal electrical equipment without proper approval from your supervisor.
- Do not store flammable liquids near electrical equipment.

For qualified personnel only (see section 4):

- Evaluate the risk prior to initiating any electrical work, please refer to section 13.
- Prior to working on electrical equipment, de-energize the power source. Lock and tag the disconnect switch. (Please refer to Lock-Out Procedure at: http://www.uottawa.ca/services/immeub/lockout.htm
- Ensure that operating procedures are up to date and appropriate for the working conditions.

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

- Never leave unprotected systems unattended.
- Use protective equipment such as safety glasses, hard hat, electrically insulated gloves when working on live circuits. Consult the Personal Protective Equipment document for appropriate personal protective equipment (PPE):
  http://www.uottawa.ca/services/ehss/reporting/PPEfinal.pdf

9.2 SPECIFIC INFORMATION ON ELECTRICAL COMPONENTS

The following sections will provide you with specific information on some electrical components

9.2.1 PLUGS

- Regularly check for loose or damaged plugs.
- You should never remove the 3rd prong – this prong exists to prevent shocks!
- Use polarized plugs (one large or wide prong and one narrow one). This ensures that the plug is inserted correctly in a socket for proper flow of electrical current.

9.2.2 ELECTRICAL CORDS

- Electrical cords must be deemed to be in good working condition before usage.
- Inspect electrical cords to ensure they are not frayed or damaged such as loose prongs, splits in the cord jacket, or heat excessively when in use.
- Extension cords or power bar must be three-pronged and appropriately sized for the intended load. Shall not be smaller than AWG#18. See table 1 for specifications.
- Ensure that the chosen electrical extension cord thickness is the same size or bigger than the electrical cord for the tool.
- Make sure the rating on the cord is the same as or higher than the number of watts needed by the product that will be plugged into the cord.
- Never overload extension cords. The cord's rating capacity is labeled on the cord. For assistance, see Section 11.
- Extension cords should not to be connected in series.
- Do not attempt to repair a damaged cord or electrical part. Have it replace instead.
- Never place cords under carpets, over or through doorways, windows or in path of travel (avoid tripping hazards).
- Electrical and extension cords must be adequately protected in the presence of traffic to avoid a safety hazard. (For temporarily use only)
- In case you need an extension cord, use only one temporarily (a few hours) and make sure it is long enough between both ends without streching it too much.
- Electrical and extension cords must not be coiled or looped when in use.
- Store all electrical and extension cords in an interior location at a temperature greater than 0°C as to not promote deterioration of the cords over time.
- Electrical cords should not be located beneath work benches where flammable chemicals are handled.

9.2.3 OUTLETS, MULTIPLE OUTLETS AND POWER BARS

- Plug only one high-wattage appliance into each receptacle outlet at a time.
- Never overload outlets by plugging in too many plugs or connected in series.
- In general, multiple outlets and power bars should be used for short-term power source solution.
- Multiple outlet with serge protector, if graded appropriately, can be used for a longer period when used for computer or low demand equipment.
- If outlets or switches feel warm, shut off the circuit and have them checked by an electrician.
- Multiple outlet surge protectors should be equipped with an automatic circuit breaker. Outlet strips with fuses or without over-current protection should not be used.
- Multiple outlet surge protectors should not have a cord greater than 6 feet in length and must be plugged directly into a wall receptacle.
- Multiple outlet surge protectors are not to be exposed to traffic unless otherwise adequately protected.
- Multiple outlet surge protectors may only be used for appliances that draw no more than 200 watts or less per outlet. Such applications include computer terminals, typewriters, or calculators. Other

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

applications, with higher wattage, are not to be connected, such as photocopiers, space heaters, microwave ovens, and refrigerators. Always verify the limit allowed before its use.

Figure1. Multiple Outlet Surge Protectors

- Multiple Outlet Surge protectors should have an on /off switch.
- Multiple Outlet Surge Protector or power bars should not be located beneath work benches where flammable chemical are handled.

9.2.4 BREAKERS

- Tripped circuit breaker problems, circuits that won't work when fuses are replaced or breakers reseting often indicate a serious electrical hazard. Report those problems to Physical Resources Service (See Section 11) and have it check by an electrician.

9.2.5 ELECTRICAL CIRCUIT PANELS OR DISCONNECTS

- Electrical panels or disconnects must never be blocked.
- Ensure a clearance of at least 1 meter from the panel.

9.2.6 ELECTRICAL EQUIPMENT USED IN WET LOCATIONS

Equipment used in wet areas must be designated and approved for use in wet locations. When it is not possible to ensure protection from contact with water, the equipment must be protected by a ground-fault circuit interrupter (GFCI).

A GFCI must be installed when an electrical outlet is at close proximity to water. For example near sinks. This includes greenhouses, animal rooms, around swimming pools and fountains, wet laboratory, outdoor receptacles, etc.

<u>GFCI, types and functions</u>

A GFCI is a device that can detect any leakage current in an electrical circuit and turns off the circuit whenever the leakage current is greater than a minimum tolerable limit, usually 5 mA. A leakage current is referred to when electricity escapes to the ground. Therefore, GFCIs are devices designed to provide protection against dangerous situations.

There are three types of GFCIs that can be used on worksites or workplaces:

1. A GFCI receptacle can be used in place of a standard receptacle.
2. A portable GFCI, when plugged into a standard receptacle, converts a standard receptacle into a GFCI one.
3. A GFCI circuit breaker combines leakage current detection with the function of a circuit breaker.

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

Figure2. Ground Fault Circuit Interrupter (GFCI)

It is important to note that GFCIs are subject to wear and therefore damage over time. For example, GFCIs may undergo damage due to a strong power surge during an electrical storm. Therefore, GFCIs should be tested regularly. The recommended frequency is once every month.

10. DETECTING DAMAGED EQUIPMENT

Electrical equipment can become damaged over time. Such damaged equipment can lead to serious injury or cause fires. The most effective method in detecting damaged electrical equipment is through visual inspection.

The following is a list of important points in discovering deficiencies in electrical equipment:

- Identify your equipment. You should know where and how it is used.
- Attempt to discover any damage, such as cuts, abrasion to the cable covering, damage to the plug.
- Verify whether the casing is cracked or the pins are bent.
- Ensure that no colored insulation of the internal wires is showing.
- Ensure that there is no damage to the outer cover of the equipment or no obvious loose parts or screws.
- Ensure that there has been no overheating of equipment which would be apparent by the presence of burn marks or staining of equipment.
- Verify that no bare wire is visible other than at the terminals.
- Ensure that the terminal screws are tight.
- Verify that there is no sign of internal damage, entry of liquid, dust or dirt.

Figure3. Damaged Electrical Cord

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

11. REPAIRING DAMAGE ELECTRICAL EQUIPMENT

Contact Physical Resources Service at extension 2222 or fill out a request form at http://www.uottawa.ca/services/immeub/helpform.htm to report the need for equipment repair, electrical failure or assistance for choosing the appropriate type of electrical cords or power bars, etc.

12. PURCHASING POLICY

Materials Management Services has developed a document, called "Business Relation Agreement with the University of Ottawa", which describes the general conditions and procedures for purchasing equipment.

Find below, Section 32 of the document, which specifies information on the electrical seals of approval:

Electrical Seal of Approval *(Reprinted from the document: " Business Relation Agreement with the U of O"):*

32.1 The source company from which the electrical equipment is being purchased must ensure that electrical equipment bears the CSA or Electrical Safety Authority (ESA)[2] seal of approval subject to one of the following options:

a) The equipment bears the CSA or ESA[1] seal of approval prior to delivery, with all relevant costs absorbed by the company OR
b) When option (a) is not possible, the University will take the necessary measures to have the equipment inspected and field approved by the CSA or an approved inspection authority[2]. Costs related to the inspection and to the approval, including the cost of minor or major changes required by CSA or an approved inspection authority[2] are to be absorbed by the source company.

Furthermore, because the University may need to unpack (if necessary) the equipment or remove it from containers to allow CSA or an approved inspection authority [2] to conduct their inspection, the company's guarantee on this equipment shall remain intact.

32.2 Important Notes

- Should the source company select option (b), this must be clearly stated in the tender.
- If an approved inspection authority deem they cannot approve the equipment in its current state and the required modifications cannot be performed on site, the University reserves the right to return the equipment to the source company, collect, without penalty to or obligation on the part of the University. The equipment in question will only be paid following CSA or an approved inspection authority[2] approval.

The text of this document can be viewed at the Material Management Services Website: http://www.uottawa.ca/services/matmgmt/mnl/mnl-p-e.htm

13. TRANSFERRING USED EQUIPMENT AND DONATIONS

This section deals with the transfer of used electrical equipment to the University of Ottawa. The origin of such equipment varies and can be from other educational institutions, government establishments or from private business and even other countries.

The regulation of such equipment is thus in the hands of the receiving party here at the University of Ottawa. That is, the individual in receipt of the transfer or donation of electrical equipment must ensure that all equipment

[1]See Section 8.1 for recognized certifications marks under the Electrical Safety Code

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

received bears the proper approval marks and must undergo inspection to validate correct and safe operation. All received equipment must follow and respect the Ontario Electrical Safety Code (See sections 8.2 and 14).

14. CERTIFYING EQUIPMENT

All electrical equipment at the University of Ottawa which does not have the approved certification marks, as defined in Section 8 on certification agency, must undergo an inspection to receive the certification by an approved inspection authority in Ontario[3].

Electrical products can only be approved by agencies that have been accredited by the Standards Council of Canada to approve electrical equipment. No other product approval markings are accepted in Ontario. Electrical Products can be approved by:

- Getting it "certified" by a recognized testing agency.
- Arranging to have the product "Field approved" by a recognized field approval agency.

You may directly contact an approved inspection Agency (see Section 8) or you can contact the Faculty of Science, Electronics Shop. They have the authority to inspect and assess the equipment to meet the ESA and CSA requirements and make any necessary modifications. The equipment can subsequently be "field approved" by the Approved Inspection Agency.

15. RISKS ASSOCIATED WITH ELECTRICITY

Everyone is exposed to electrical energy during the performance of their daily duties. Therefore, it is important to understand potential electrical hazards present in your environment in order to recognize, evaluate and control hazards associated with the electricity.

EVALUATION OF RISK

The evaluation of risk is a critical component to the prevention of electrical injuries. Therefore, it is of the utmost importance to include a procedure around which risk can be analyzed. Electricity can hurt you by electrical contact, flash or fire and explosion. All individuals who are exposed to electrical equipment in any manner should consider the following factors. The consideration of these factors will facilitate the evaluation of the risk of injury around electrical equipment:

A. The environment in which the electrical equipment is used:

- Condition - wet or dry
- Location - indoors or outdoors
- Spacing - open or crowded
- Lighting - lit or dim
- Existence of hazards such as metal ladders, overhead wires, presence of electrical conductors, electrical cords over a heat source, or overloaded electrical outlets

B. Condition of the electrical equipment in use:

- Presence and integrity of grounding system
- State and age of equipment
- Presence of internal safety mechanisms
- The actual operating voltage
- The electrical wiring and loads incurred

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

15.1 ELECTRICAL SHOCK

Shocks happen due to electrical current (amperes) flowing through the human body. Misunderstanding often plays a part in these unfortunate accidents in the workplace. Turning to "off" an electrical equipment doesn't mean there is no electricity in it. As long as the equipment is plugged into an outlet, parts of it are still "live". Cleaning a switched-off, but still plugged-in coffee pot in the kitchen sink, can be fatal.

15.2 FIRE HAZARDS

Electrical fires can be caused by overloads on circuits not meant to carry the current flowing through them, and by poor electrical connections. A short circuit occurs when the normal current path is changed, by passing through broken insulation or a bad connection to another conductor - thus causing the short circuit. As a result of the short circuit, a very hot spark or electric arc occurs, which can ignite insulation or nearby combustibles.

15.2.1 EXTINGUISHERS

Use "ABC", "BC" or "C" class fire extinguishers for electrical fires only if the individual has received the proper training.

15.3 TYPE OF INJURIES

Electrical injuries consist of five main types: electrocution, electric shock, amputation, burns and falls. The severity of an electric shock depends on the following factors:

- The intensity of the current running through the body
- The path of the current (an 80 milliampere current that passes through the heart is enough to trigger a heart attack)
- The duration of contact with the current source
- The body's resistance: This is the deciding factor in an electrical accident. The intensity of the shock increases when the body's resistance decreases.

Examples of injury sustained with different amount of current:

Amount of Current (mA)*	Type of Injury Sustained
0.5 -3	Energy sense begins, a tingling sensation can be felt
3 -10	Threshold around which pain is experienced, muscle contractions occur
10 – 30	Grip paralysis threshold in which despite efforts to do so, the individuals cannot detach themselves from the energy source
30 – 75	Respiratory systems ceases to operate
100 – 200	Heart fibrillation begins
200 – 500	Heart clenches tightly
≥ 1,500	Organs and tissues are burnt

* Based upon a 60 Hz AC

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

16. EMERGENCY

In the case of an emergency related to electrical shock or injuries derived from electrical equipment, it is critical to follow a set procedure in order to minimize damages and most importantly, to save lives. Regardless of the perceived severity of the injury, ensure the injured person receives professional medical attention as soon as possible. Injured persons have experienced heart failure hours subsequent to the initial exposure to electricity.

PROCEDURES

In case of an emergency, immediately contact Protection Services by pressing the emergency button or dialing extension 5411. Protection Services will provide assistance by dispatching an officer, contacting an ambulance and the Fire Department as necessary.

Attempt to separate the person from the energy source only if it is safe to do so and move the injured person into a safe area, away from the electrical source.

- Do not attempt to remove the injured person from the electrical source directly with your hands as you will essentially become part of the circuit and injure yourself in the process. In order to remove or detach the injured person from the electrical source use a non-conductive material such as dry wood, plastic or leather.
- Should you be qualified to do so, administer first-aid until further assistance arrives, unless the injured person refuses.

[2] See Section 8.2 for Field Evaluation Marks under the Electrical Safety Code

17. GLOSSARY

Term	Definition
ESA	Electrical Safety Authority
CSA	Canadian Standards Association
GFCI	Ground Fault Circuit Interrupter – detects grounding problems and turns electricity off to prevent a possible accident
Amps	The standard unit for measuring electrical current
Watt	A unit of electrical power, equal to the power developed in a circuit by a current of one amp flowing through a potential difference of one volt
Voltage	Electromotive force expressed in volts
Circuit Breaker	A device that automatically interrupts the flow of an electrical current
Current Flow	The rate of flow of an electrical charge, generally expressed in amps
Lockout	The placement of a lock on an energy-isolating device. This act prevents workers from operating a piece of equipment until the lock is removed
Tagout	The placement of a tag on an energy-isolating device. A Tagout device is a prominent warning device of a lockout.

Table 1
Information extracted form the Ontario Electrical Safety Code, 20 th Edition

Allowable Ampacity of Flexible Cord and Equipment Wire
Based on Ambient Temperature of 30 degree Celcius.

Size AWG	Allowable Ampacity							
	Flexible Cord						Equipment Wire	
	Tinsel Cords	Christmas-tree Cord	Types E, EO,ETT	Types PXWT, SV,SVO,SJ‡,SJO‡, SJOW, S‡,SO‡, SOW, SPT-1' SPT-2,SPT-3, SVT**,SJT‡, SJTW,ST‡,STW		Types HSJO‡, HPN, DRT	Types TXF, TXFW	Types GTF*, TEW*,SEW*,REW*, TEWN*,SEWF*,TBS*, SIS*
	Types TPT, TST	Types CXWT, PXT		2 Current-Carrying Conductors	3 Current-Carrying Conductors*			
27	0.5	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	1
24	-	-	-	-	-	-	-	2
22	-	-	-	-	-	-	-	3
20	-	2	-	2	-	-	2	4
18	-	5	5	10	7	10	5	6
16	-	7	7	13	10	15	7	8
14	-	-	15	18	15	20	-	17
12	-	-	20	25	20	25	-	23
10	-	-	25	30	25	30†	-	28
8	-	-	35	40	35	40†	-	40
6	-	-	45	55	45	50†	-	55
4	-	-	60	70	60	60†	-	70
3	-	-	-	-	-	-	-	80

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