

ECAO/IBEW TRADE SAFETY ADVISORY

Electrical contact accounts for about one fifth of all construction deaths. This alert covers two areas of concern to electricians: using multimeters and troubleshooting.

MULTIMETERS

In the process of troubleshooting, electricians face the risk of injury from improper multimeter selection or use. Multimeters designed to meet the International Electro-technical Commission (IEC) 1010 and overvoltage category standards, when properly used, offer the electrician an acceptable level of protection that is recognized by the electrical industry.

Why use overvoltage category rated multimeters?

Momentary high-voltage transients or spikes can travel through a multimeter at any time and without warning. Motors, capacitors, lightning, and power conversion equipment, such as variable speed drives, are all possible sources of spikes.

The IEC 1010 standard defines categories I through IV that are abbreviated as CAT I, CAT II, etc. The higher-numbered categories represent an electrical environment that is susceptible to higher-energy spikes. For example, multimeters designed to the CAT IV standard provide the worker more protection from high transient voltage spikes than do CAT III, CAT II, or CAT I designs. See the accompanying diagram and table for explanation of each category.

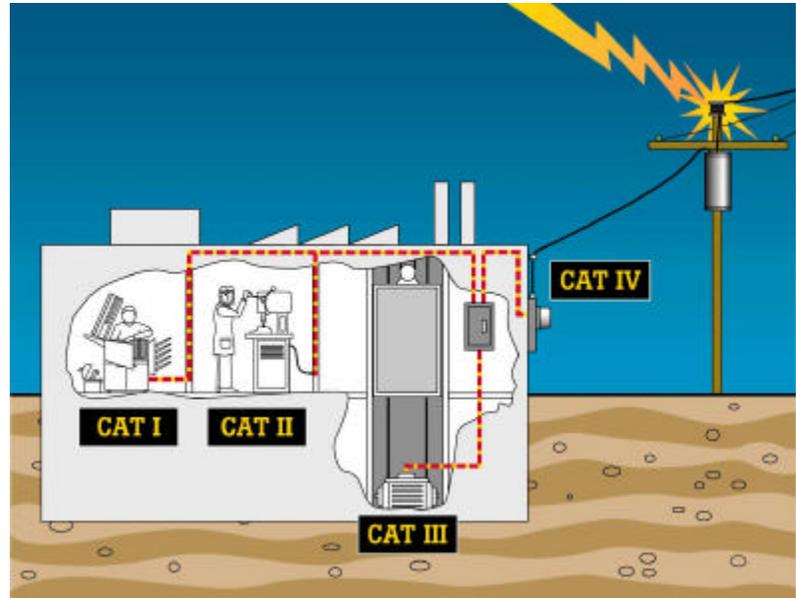
Be sure the multimeter model has been tested. Simply being designed to CAT III, for example, does not mean the multimeter was also *tested* to that standard. **Look for proof of independent testing by an organization accredited by the Standards Council of Canada, such as the CSA International (Canadian Standards Association) logo, along with the appropriate category rating on the equipment.** Test leads should also be rated at the same or greater voltage than the multimeter.

Safe Use of Multimeters

- Use only multimeters that display **both** the CSA logo (or equivalent) **and** the CAT (I, II, III, or IV) designation. *Categories I through IV apply to low voltage (less than 1000V) test equipment.*
- Check and ensure that the meter's voltage rating is appropriate for the work being done. *Be aware of multimeters with maximum voltage ratings typical of other countries (550V for example).*
- Use personal protective equipment such as eye protection, flame-resistant clothing, long sleeve shirts, dielectric safety boots, rubber gloves with leather protectors, mats, blankets, and shields.
- Check the manufacturer's manual for special cautions. Moisture and cold may affect the performance of your meter. Section 93 of the construction regulation (O.Reg.213/91) requires that tools and equipment be used in accordance with the operating manual issued by the manufacturer.
- Wipe the multimeter and test leads clean to remove any surface contamination prior to use.
- Ensure that test leads are in the correct input jacks.
- Start testing with high ranges of the multimeter, then move to the lower ranges when the values to be measured are uncertain.
- Connect to ground first, and disconnect from ground last.
- Test the multimeter on a known power source to verify the meter's proper function before and after testing the suspect circuit.

Understanding Overvoltage Installation Categories

The division of a power distribution system into categories is based on the fact that a dangerous high-energy transient such as a lightning strike will be attenuated or dampened as it travels through the impedance (ac resistance) of the system. A higher CAT number refers to an electrical environment with higher power available and higher-energy transients. Thus a multimeter designed to a CAT III standard is resistant to much higher-energy transients than one designed to CAT II standards. *Categories I through IV apply to low voltage (less than 1000V) test equipment.*



Overvoltage Category	In Brief	Examples
CAT IV	Three-phase at utility connection, any outdoors conductors	<ul style="list-style-type: none"> Refers to the "origin of installation", i.e., where low-voltage connection is made to utility power. Electricity meters, primary overcurrent protection equipment. Outside and service entrance, service drop from pole to building, run between meter and panel. Overhead line to detached building, underground line to well pump.
CAT III	Three-phase distribution, including single-phase commercial lighting	<ul style="list-style-type: none"> Equipment in fixed installations, such as switchgear and polyphase motors. Bus and feeder in industrial plants. Feeders and short branch circuits, distribution panel devices. Lighting systems in larger buildings. Appliance outlets with short connections to service entrance.
CAT II	Single-phase receptacle connected loads	<ul style="list-style-type: none"> Appliance, portable tools, and other household and similar loads. Outlet and long branch circuits. <ul style="list-style-type: none"> Outlets at more than 10 meters (30 feet) from CAT III source. Outlets at more that 20 meters (60 feet) from CAT IV source.
CAT I	Electronic	<ul style="list-style-type: none"> Protected electronic equipment. Equipment connected to (source) circuits in which measures are taken to limit transient overvoltages to an appropriately low level. Any high-voltage, low-energy source derived from a high-winding resistance transformer, such as the high-voltage section of a copier.

TROUBLESHOOTING

Electrical Hazards

Troubleshooting live electrical equipment can be dangerous. A major cause of accidents involving electrical contact comes from the failure to identify the hazards associated with live electrical equipment and wiring. Making contact with a live circuit can result in serious injury or death. A 125 volt, 15 amp circuit can deliver many times the current flow that is capable of causing death. Current as low as 30 mA (1 mA = 1/1000 of 1 amp) could cause breathing to stop. Even minimal electrical contact can cause involuntary physical movements that could result in making contact with a higher voltage, or cause a loss of balance and a fall. **When practicable, equipment must be de-energized first, and lock out and tagging procedures put in place prior to starting work.**

Workers must take adequate precautions and use appropriate personal protective equipment (PPE), clothing, and devices to protect themselves against any hazards they may be exposed to. Employers, supervisors, and workers each have legal responsibilities to ensure that the work is being carried out in a safe manner.*

Basic Safety Precautions

- Use appropriate PPE such as eye protection, flame-resistant clothing, long sleeve shirts, dielectric and oil-resistant safety boots, rubber gloves with leather protectors, mats, blankets, and shields.
- Use multimeters that have been tested. Look for proof of independent testing by an organization accredited by the Standards Council of Canada, such as the *CSA International (Canadian Standards Association) logo*, along with the appropriate overvoltage category (CAT I, II, III, or IV) on the equipment. Follow the manufacturer's instructions for specific precautions and become familiar with their proper use and limitations.
- Be prepared. It may be necessary to work in hot, cold, or wet weather conditions. Take steps to remove or protect against hazards such as slipping (which may result in electrical contact) or arcing, created by snow, humidity, or water in the work area.
- Use a ground fault circuit interrupter (GFCI) when using electric tools outdoors or in wet conditions. Only type "A" GFCIs are designed to trip at about 5 mA, offering adequate protection to a worker.
- Observe the *Ontario Electrical Safety Code*. Section 2-300 requires operating electrical equipment to be kept in safe and proper working condition, and the repair or permanent disconnection of any defective equipment.

Communicate and implement appropriate lockout procedures when troubleshooting is complete.

* Sections 181 through 195 of the construction regulation (O.Reg.213/91) set out the provisions applying to construction work in proximity to live installations and sections 40 through 44 of the Ontario Regulations for Industrial Establishments set out the provisions applying to non-construction work in industrial establishments. The *Occupational Health and Safety Act* sets out further obligations on employers, supervisors, and employees in sections 25, 27, and 28.



ECAO/IBEW Trade Labour-Management Health and Safety Committee



Construction Safety Association of Ontario, 1-800-781-CSAO (2726), www.csao.org